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(54) **DEVICE, METHOD, AND GRAPHICAL USER INTERFACE FOR MOVING A CURSOR ACCORDING TO A CHANGE IN AN APPEARANCE OF A CONTROL ICON WITH SIMULATED THREE-DIMENSIONAL CHARACTERISTICS**

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None
See application file for complete search history.

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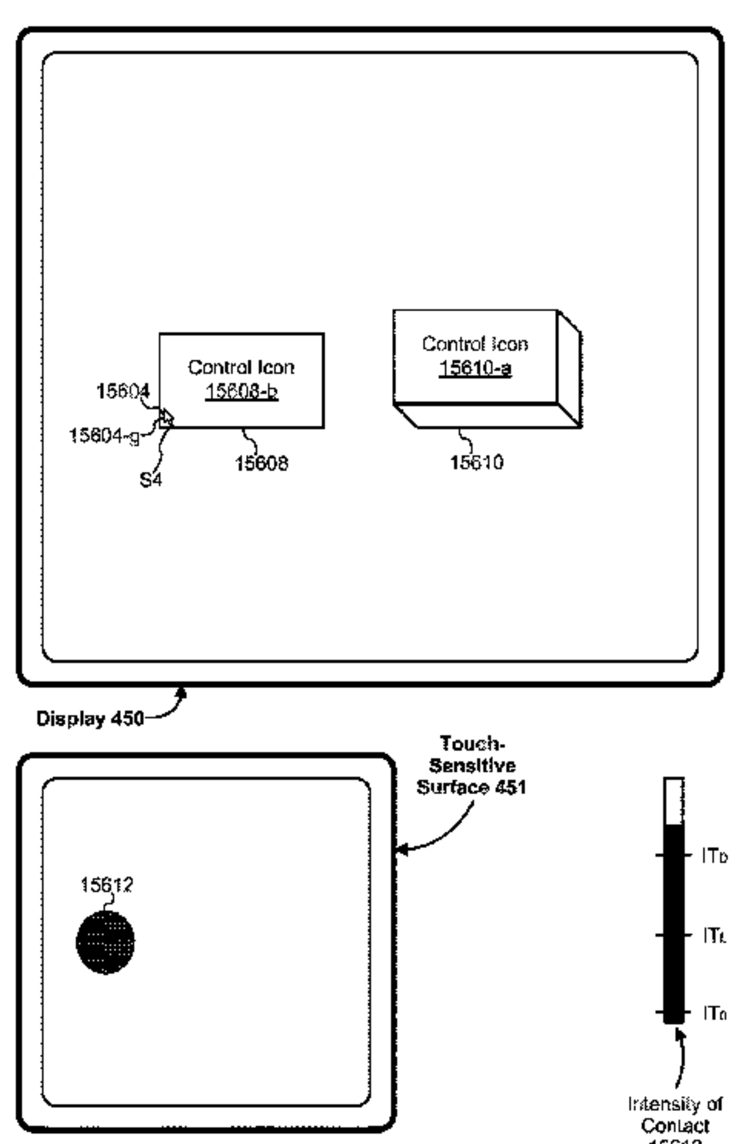
(57) **ABSTRACT**

An electronic device with a display, a touch-sensitive surface and one or more sensors to detect intensity of contacts with the touch-sensitive surface displays a respective control icon with simulated three-dimensional characteristics and a cursor over the respective control icon. The device detects, on the touch-sensitive surface, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor. In response to detecting the stationary press input, the device changes an appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the control icon and moves the cursor laterally on the display in accordance with the change in appearance of the respective control icon.

27 Claims, 59 Drawing Sheets



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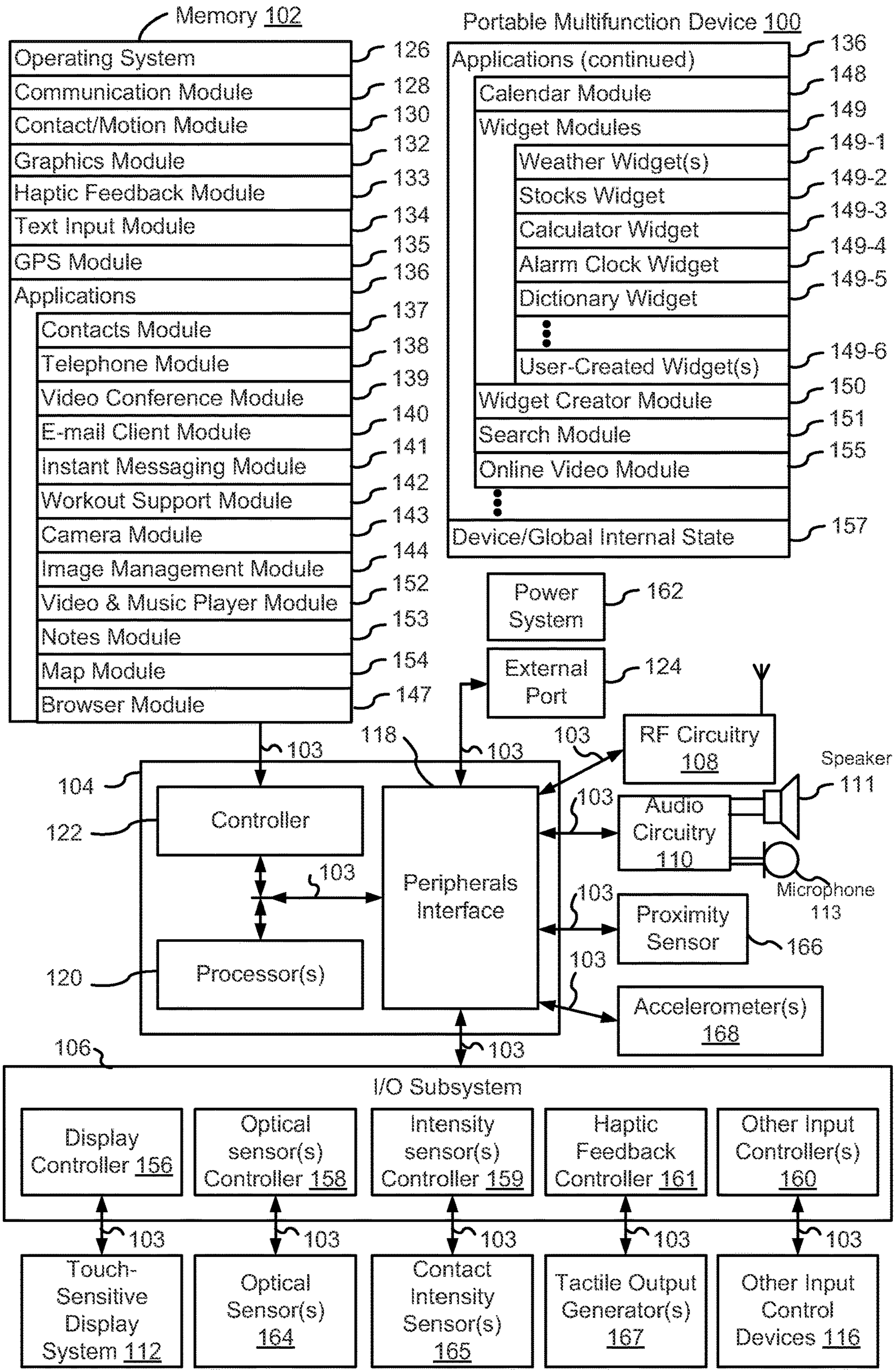
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Contact Intensity Sensor(s) 165
Tactile Output Generator(s) 167
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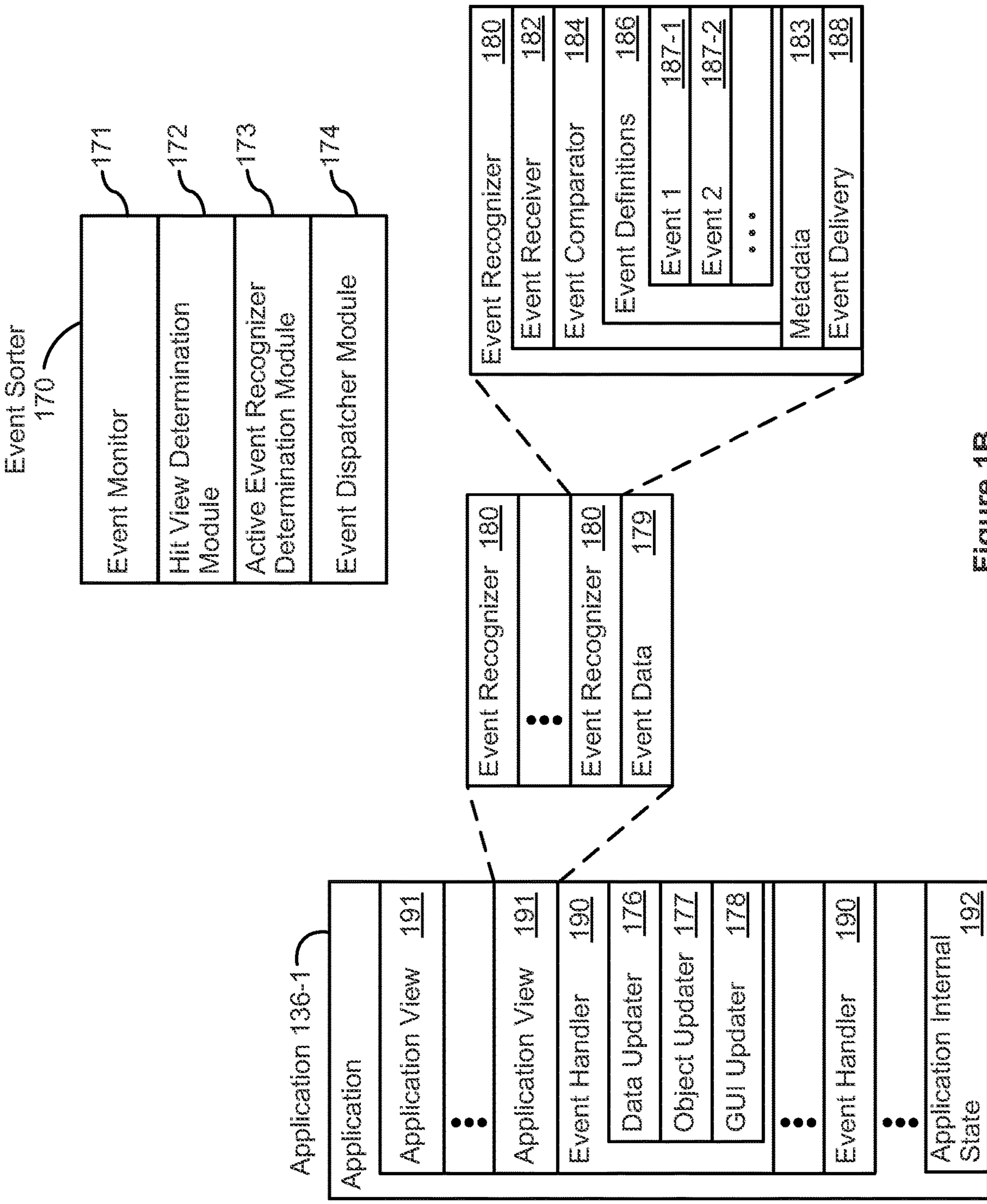
Figure 1A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Event 2 187-2
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Event Data 179
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Figure 1B

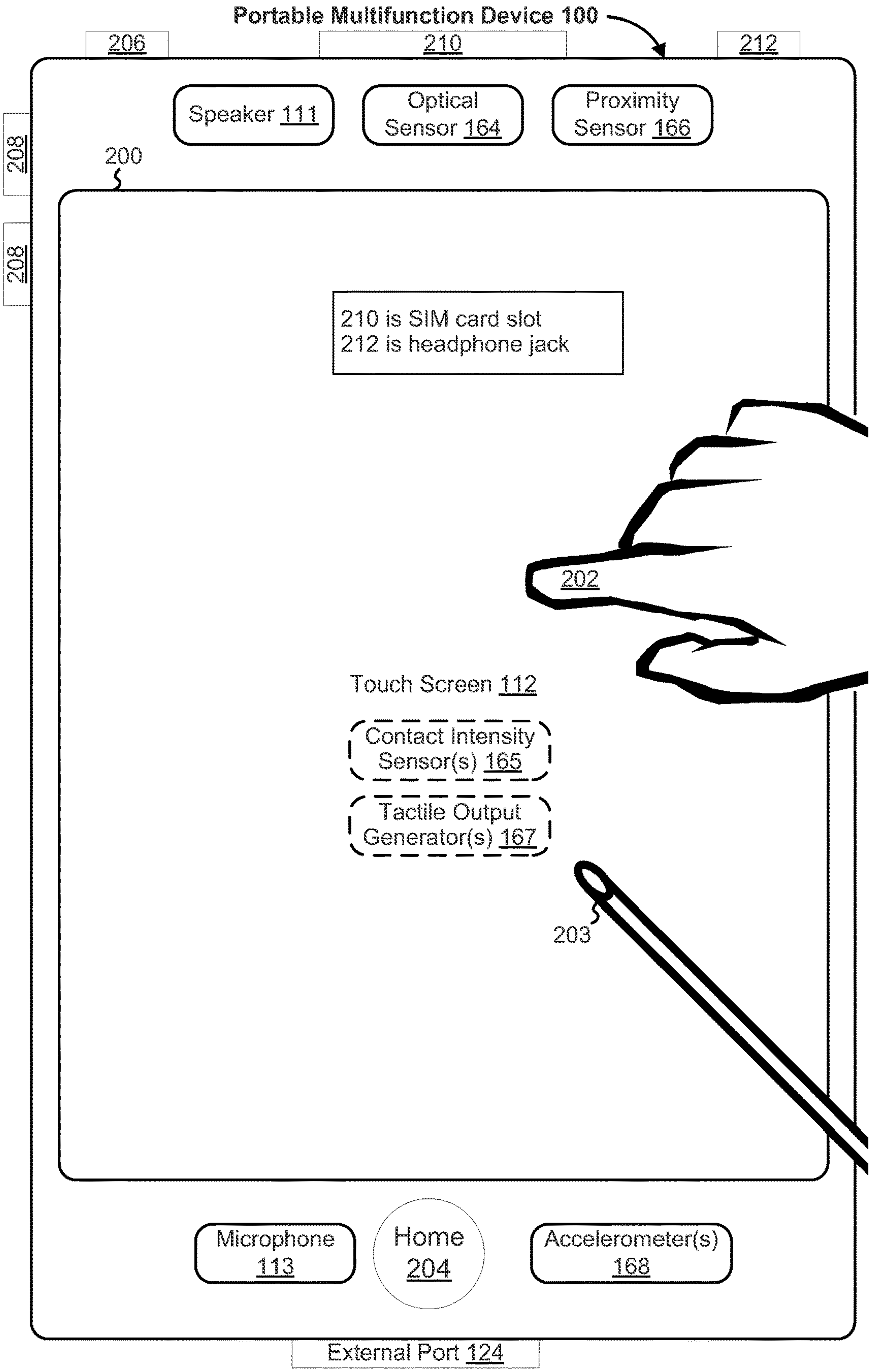
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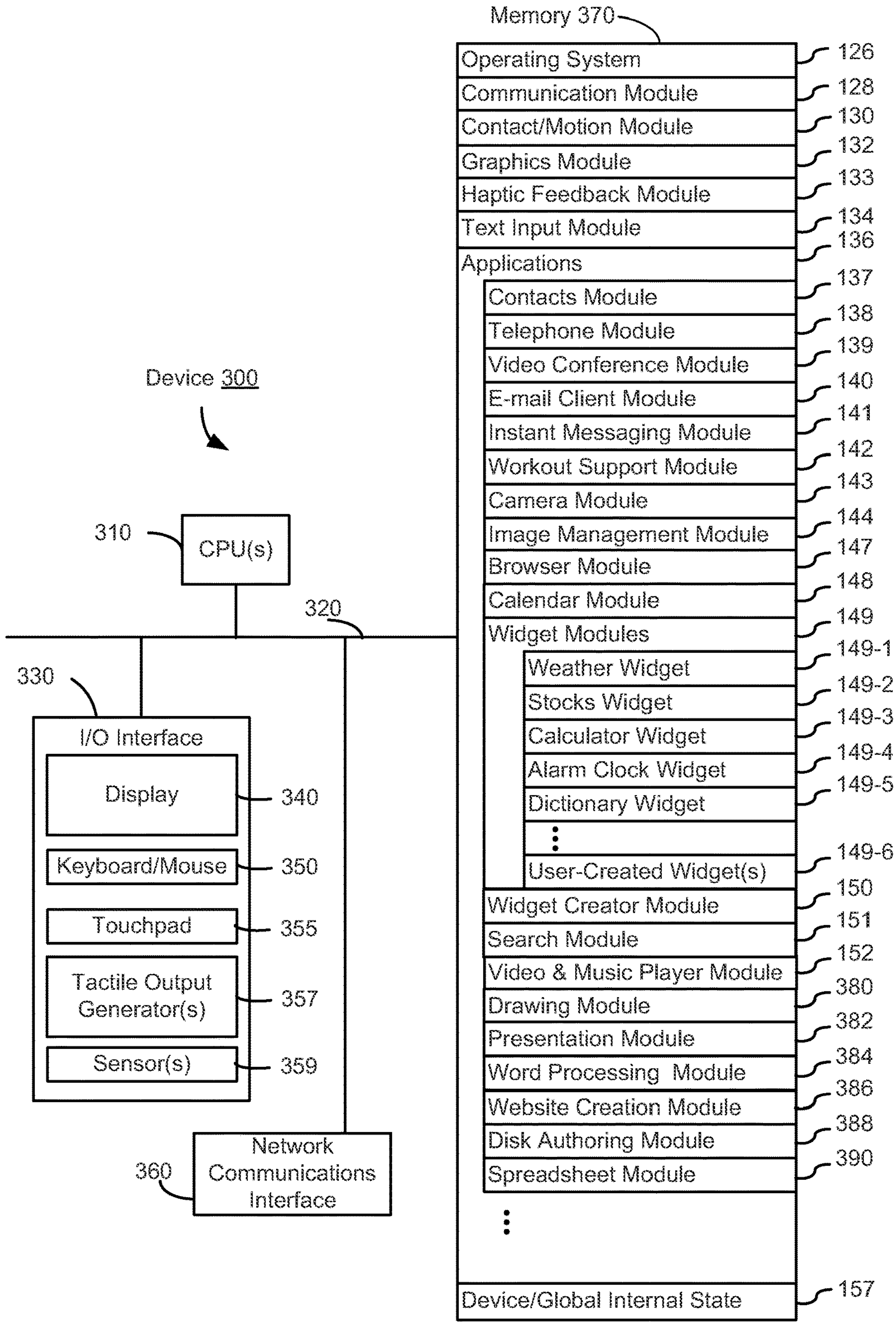
Figure 2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149-5
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Search Module
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Video & Music Player Module
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Presentation Module
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Word Processing Module
384
Website Creation Module
386
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Spreadsheet Module
390
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157
Device 300
310
CPU(s)
320
330
I/O Interface
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Sensor(s)
359
360
Network Communications Interface

Figure 3

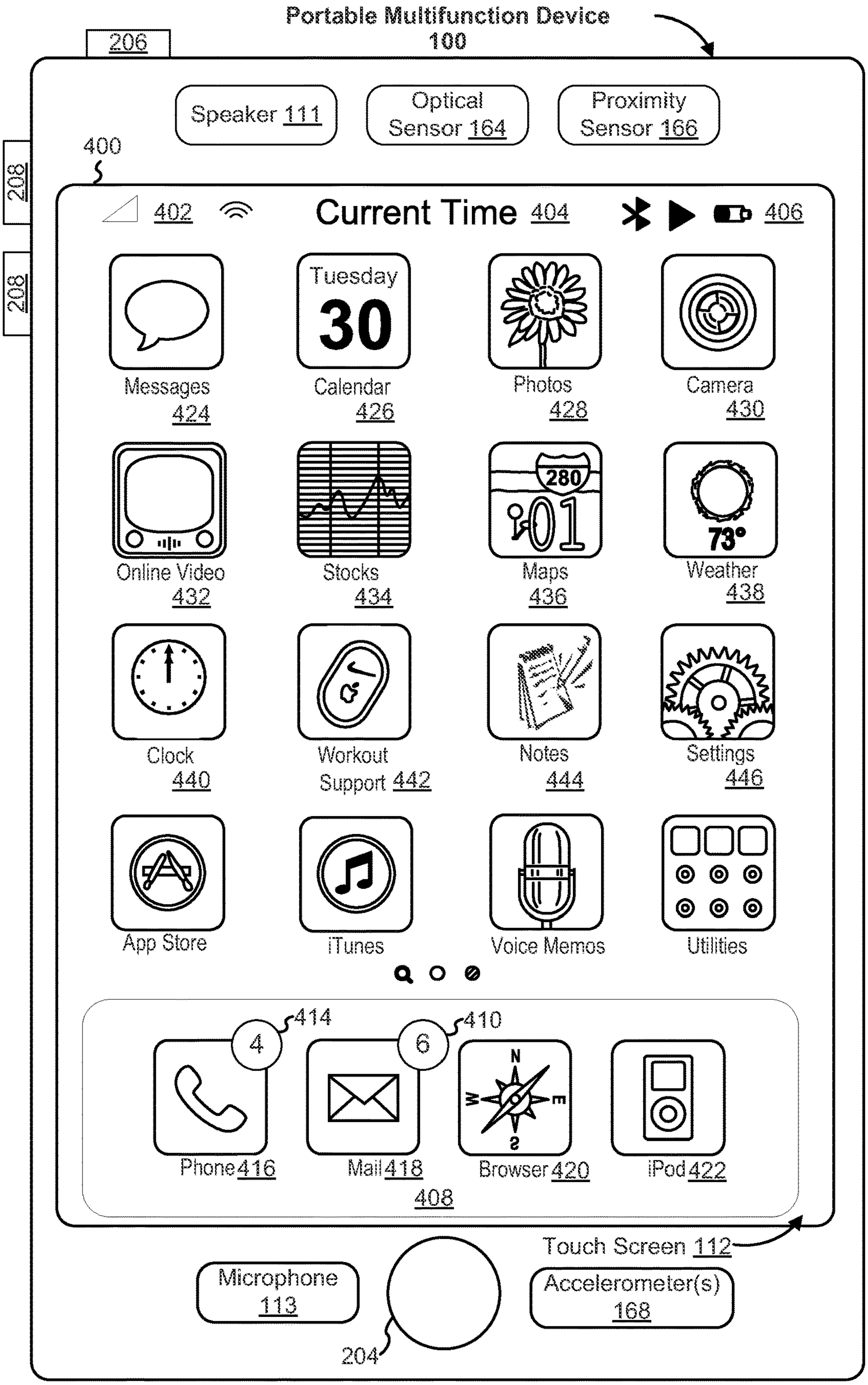
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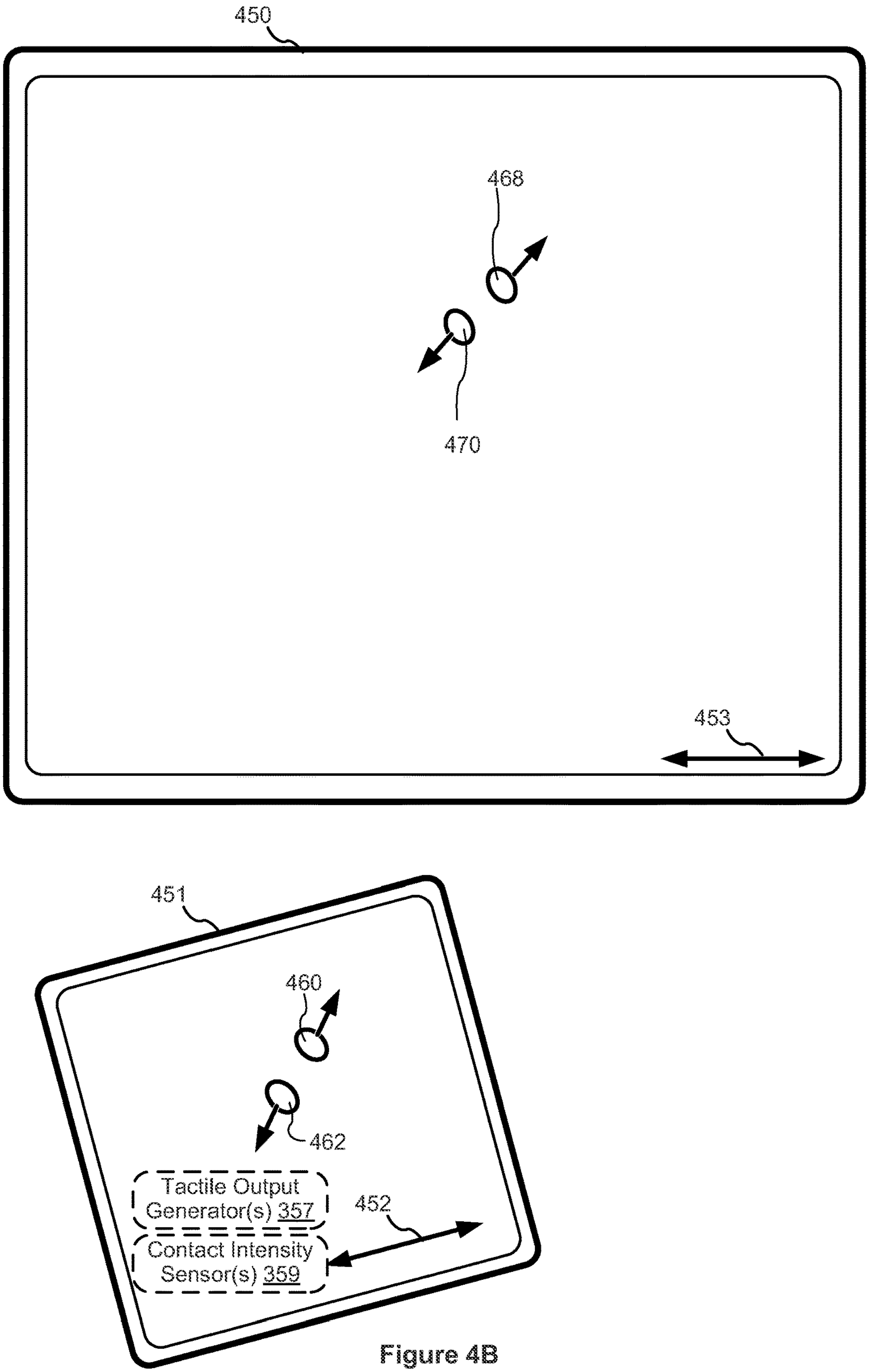
Figure 4A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452

Figure 4B

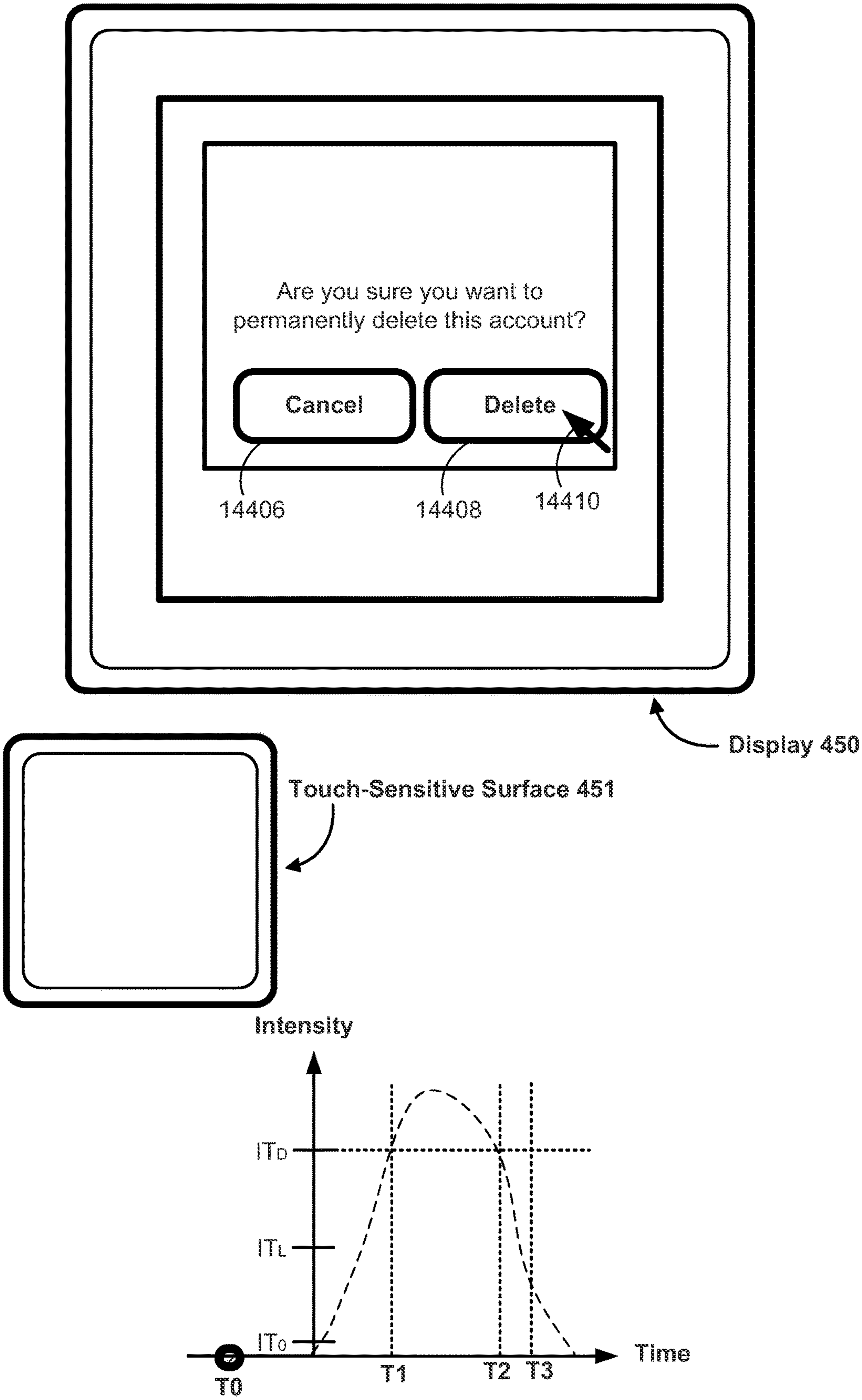

Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14410
Display 450
Touch-Sensitive Surface 451
Intensity
IT_D
IT_L
IT_0
T0
T1
T2
T3
Time

Figure 5A

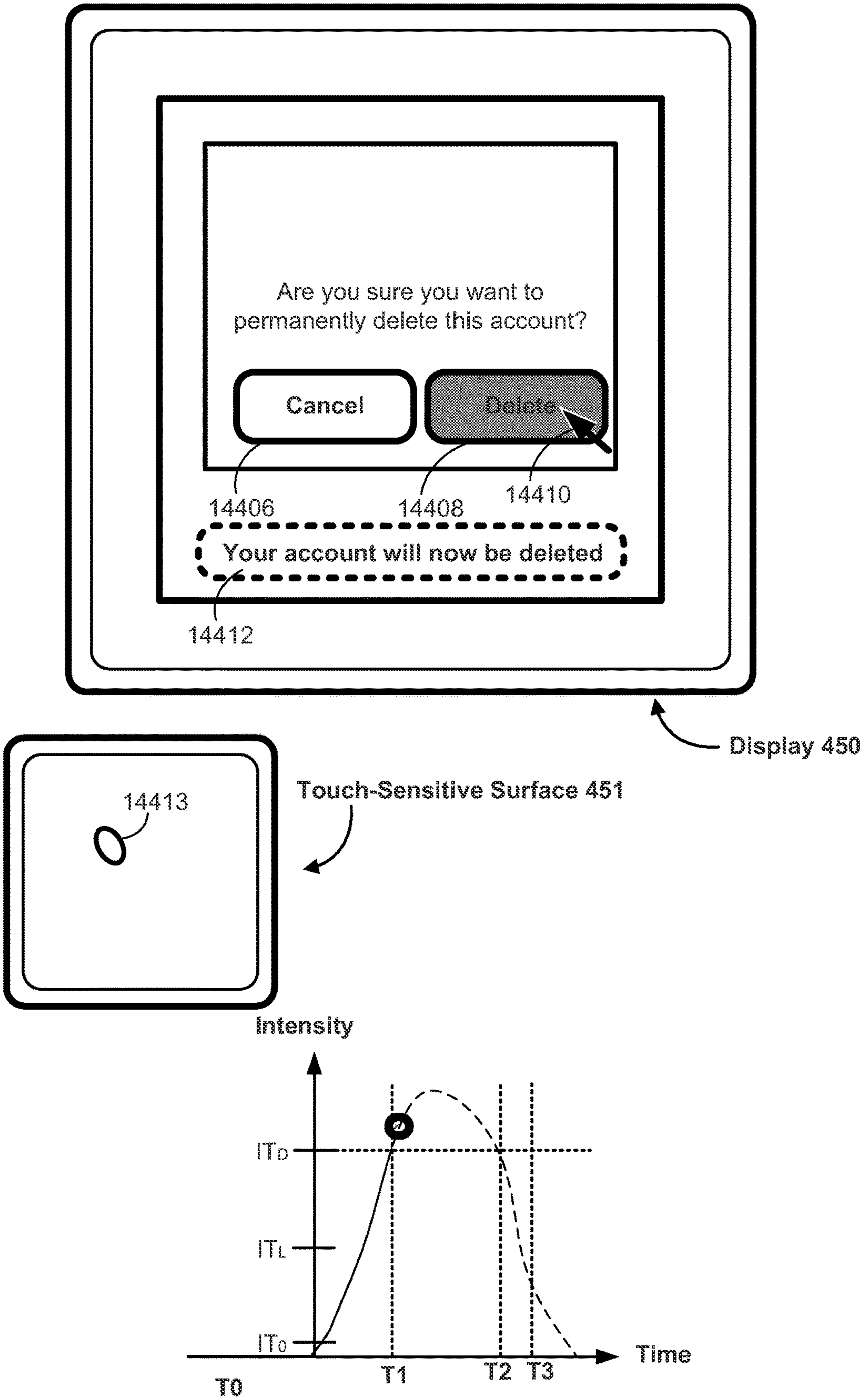
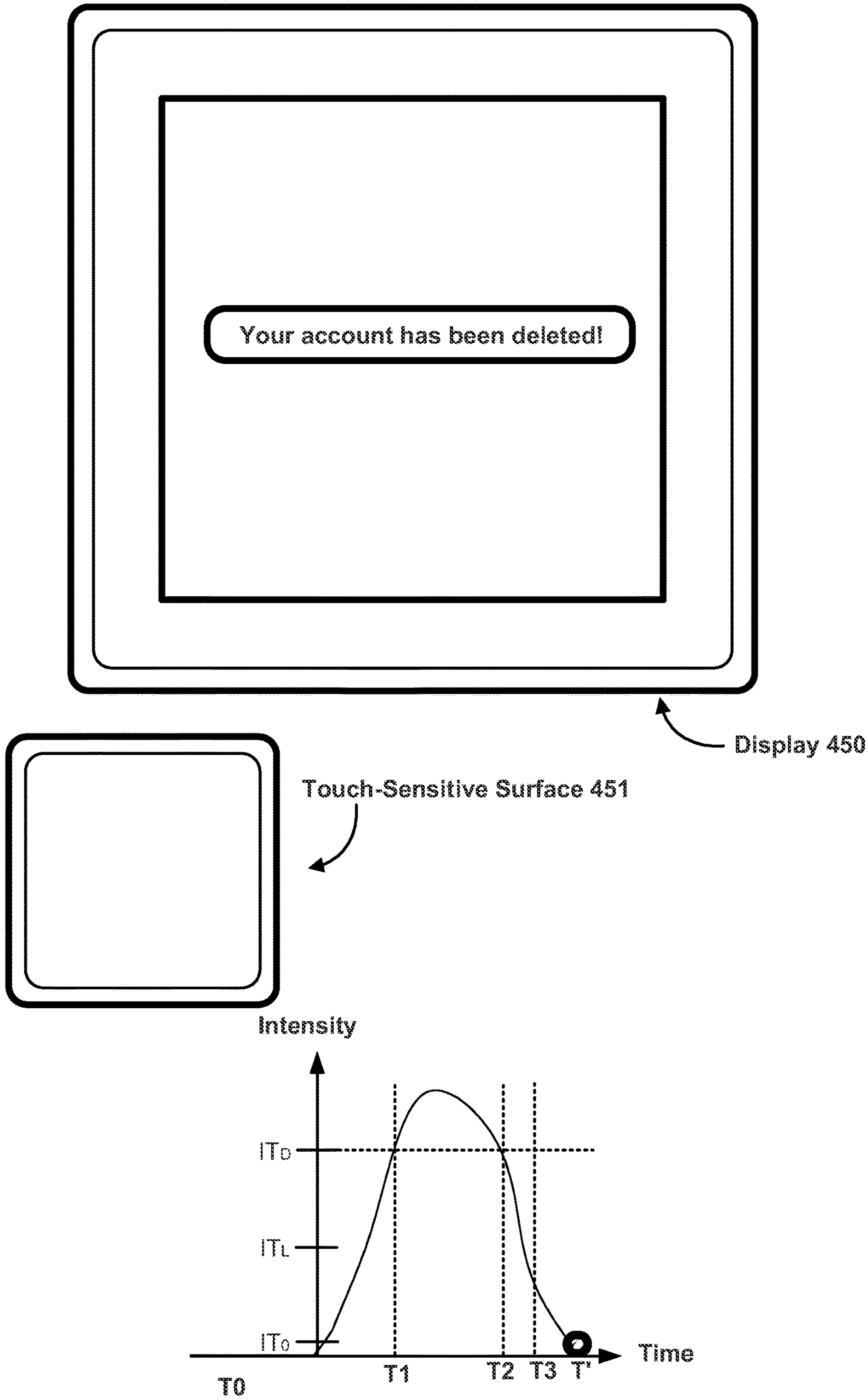

Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14410
Your account will now be deleted
14412
Display 450
Touch-Sensitive Surface 451
14413
Intensity
ITD
ITL
IT0
Time
T0
T1
T2
T3

Figure 5B



Your account has been deleted!
Display 450
Touch-Sensitive Surface 451
Intensity
ITD
ITL
IT0
T0
T1
T2
T3
T'
Time

Figure 5C

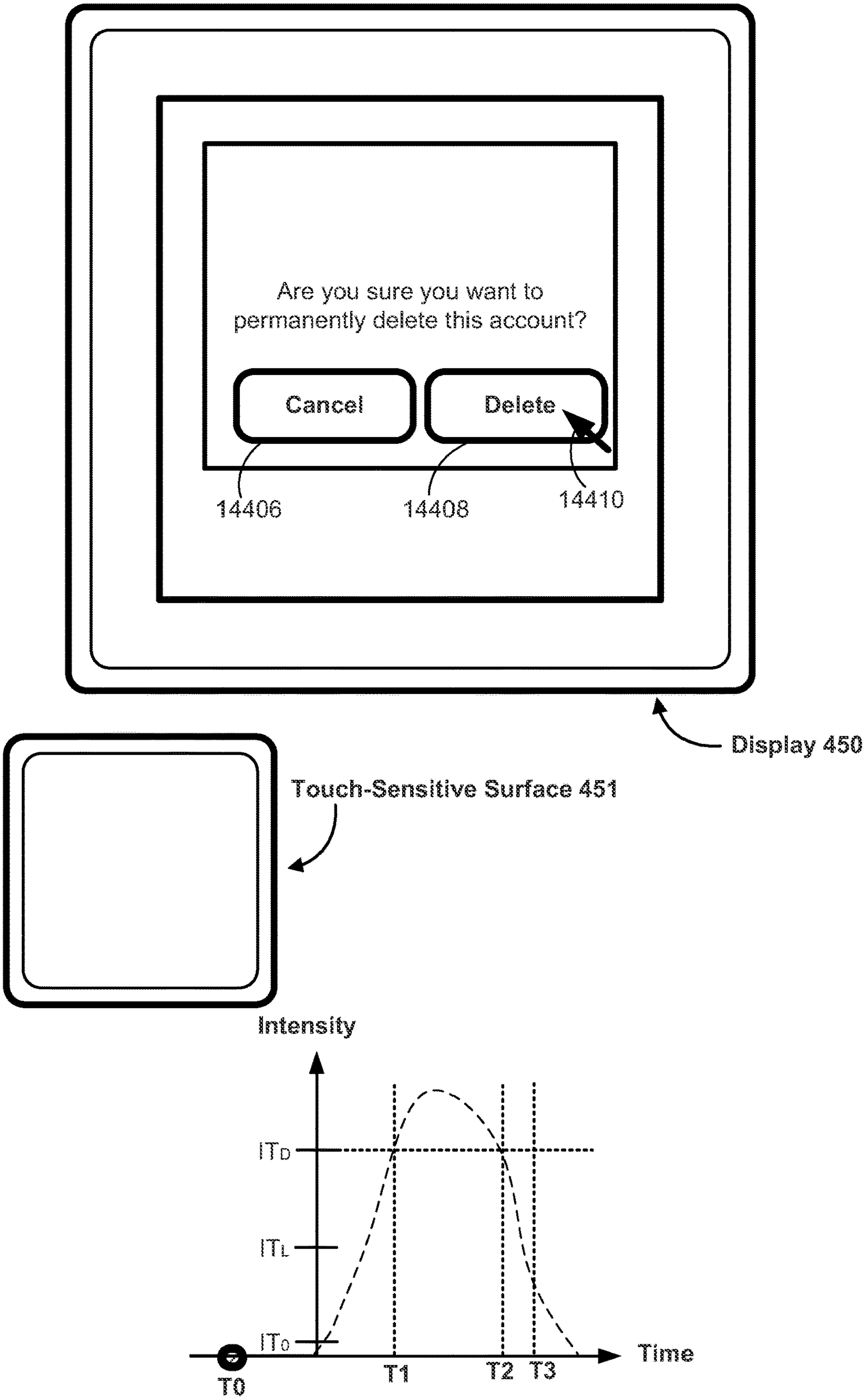

Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14410
Display 450
Touch-Sensitive Surface 451
Intensity
IT_D
IT_L
IT_0
Time
T0
T1
T2
T3

Figure 5D

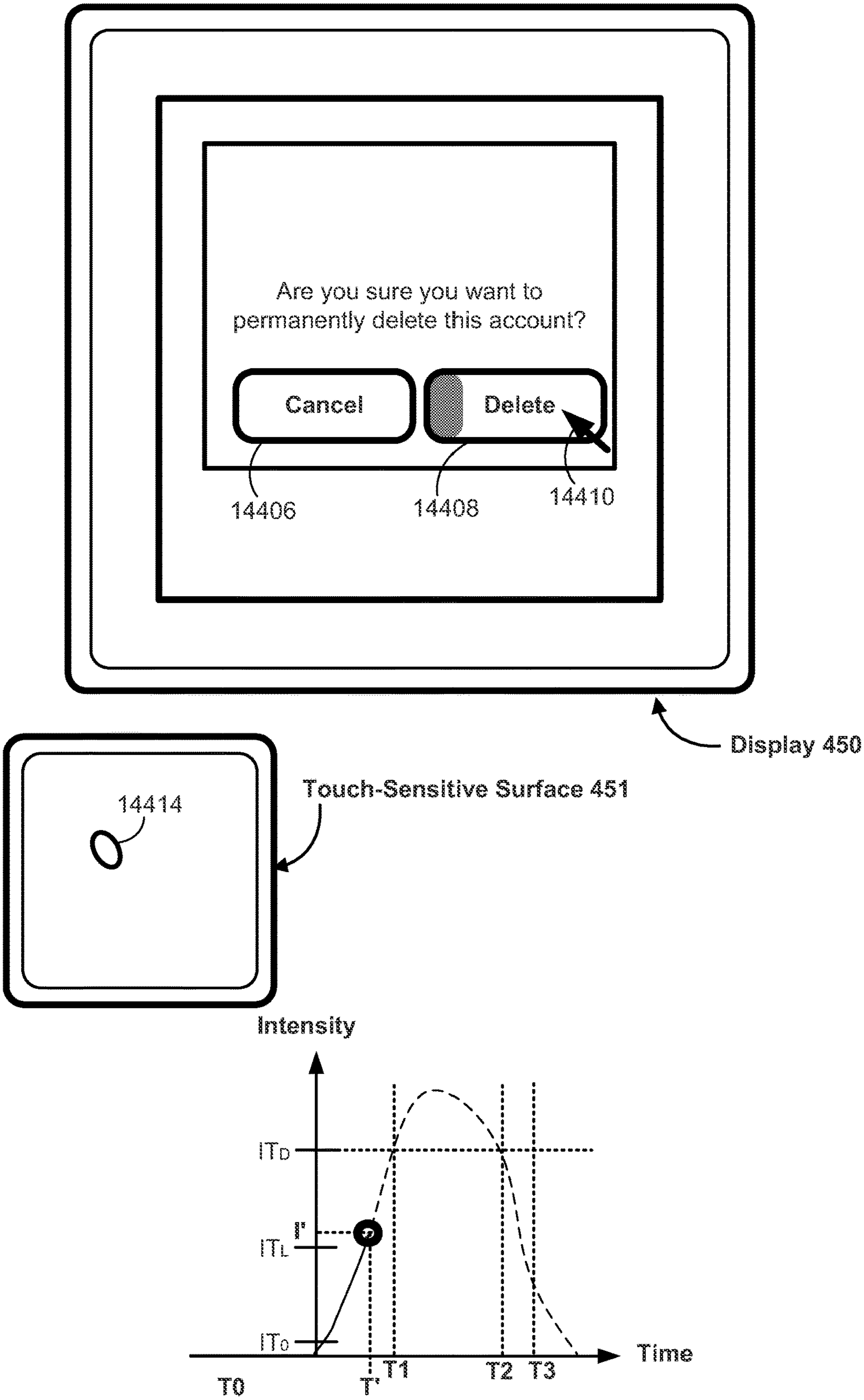

Are you sure you want to
permanently delete this account?
Cancel
Delete
14406
14408
14410
Display 450
14414
Touch-Sensitive Surface 451
Intensity
ITD
I'
ITL
IT0
T0
T'
T1
T2
T3
Time

Figure 5E

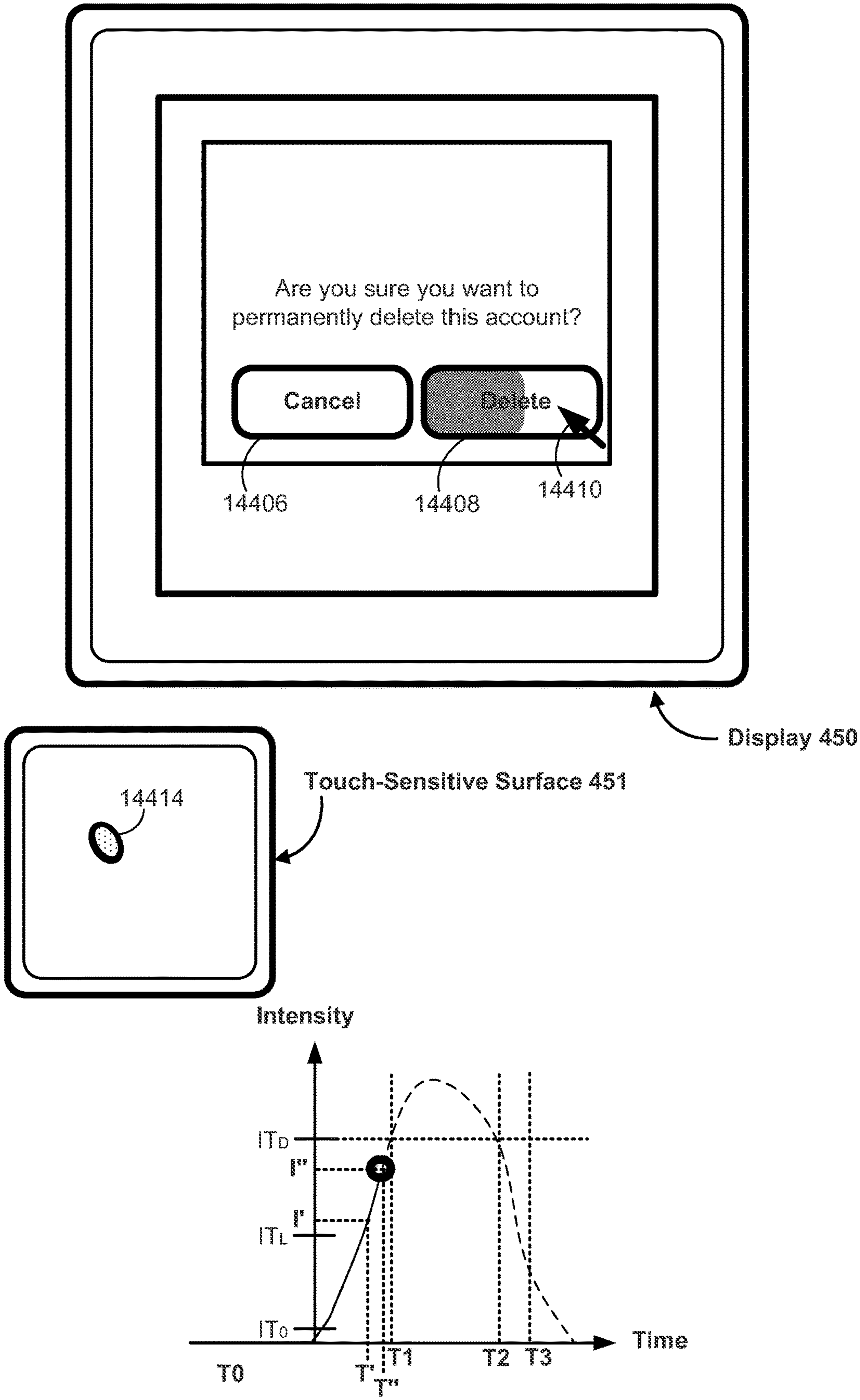

Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14410
Display 450
Touch-Sensitive Surface 451
14414
Intensity
ITD
I"
I'
ITL
IT0
Time
T0
T'
T"
T1
T2
T3

Figure 5F

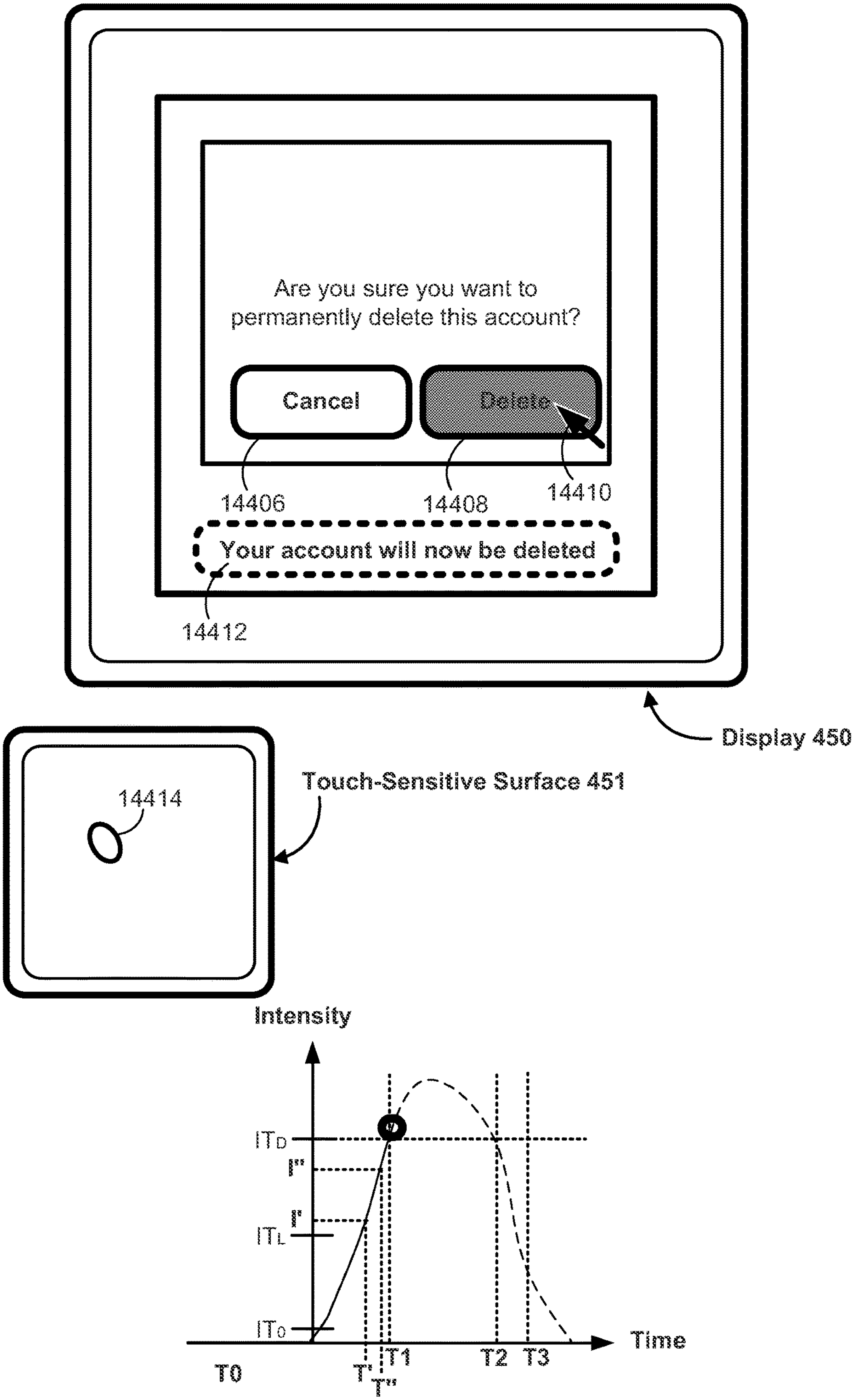

Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14410
Your account will now be deleted
14412
Display 450
Touch-Sensitive Surface 451
14414
Intensity
ITD
I''
I'
ITL
IT0
Time
T0
T'
T''
T1
T2
T3

Figure 5G

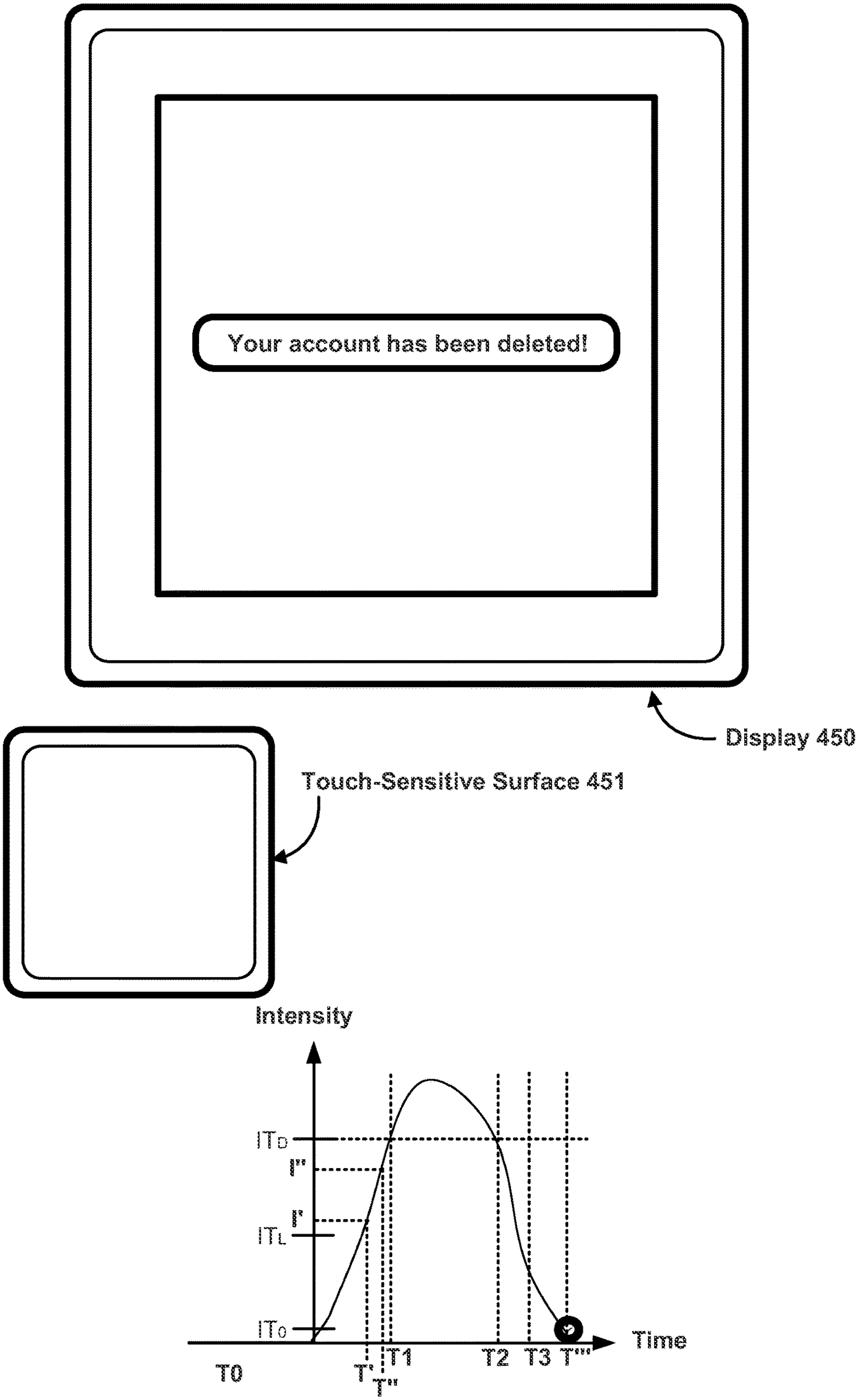
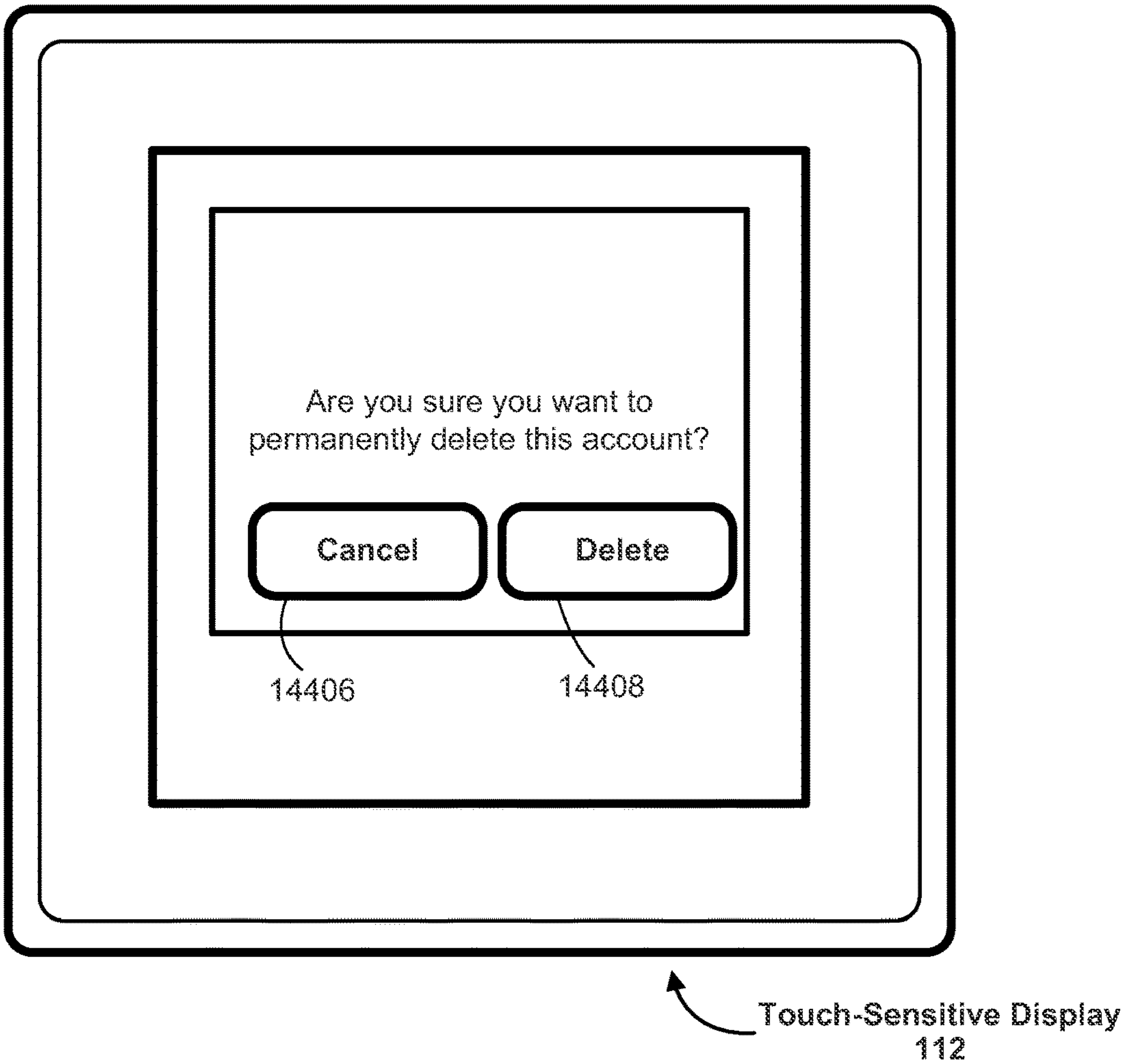

Your account has been deleted!
Display 450
Touch-Sensitive Surface 451
Intensity
IT_D
I''
I'
IT_L
IT_0
Time
T0
T'
T''
T1
T2
T3
T'''

Figure 5H


Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
Touch-Sensitive Display 112

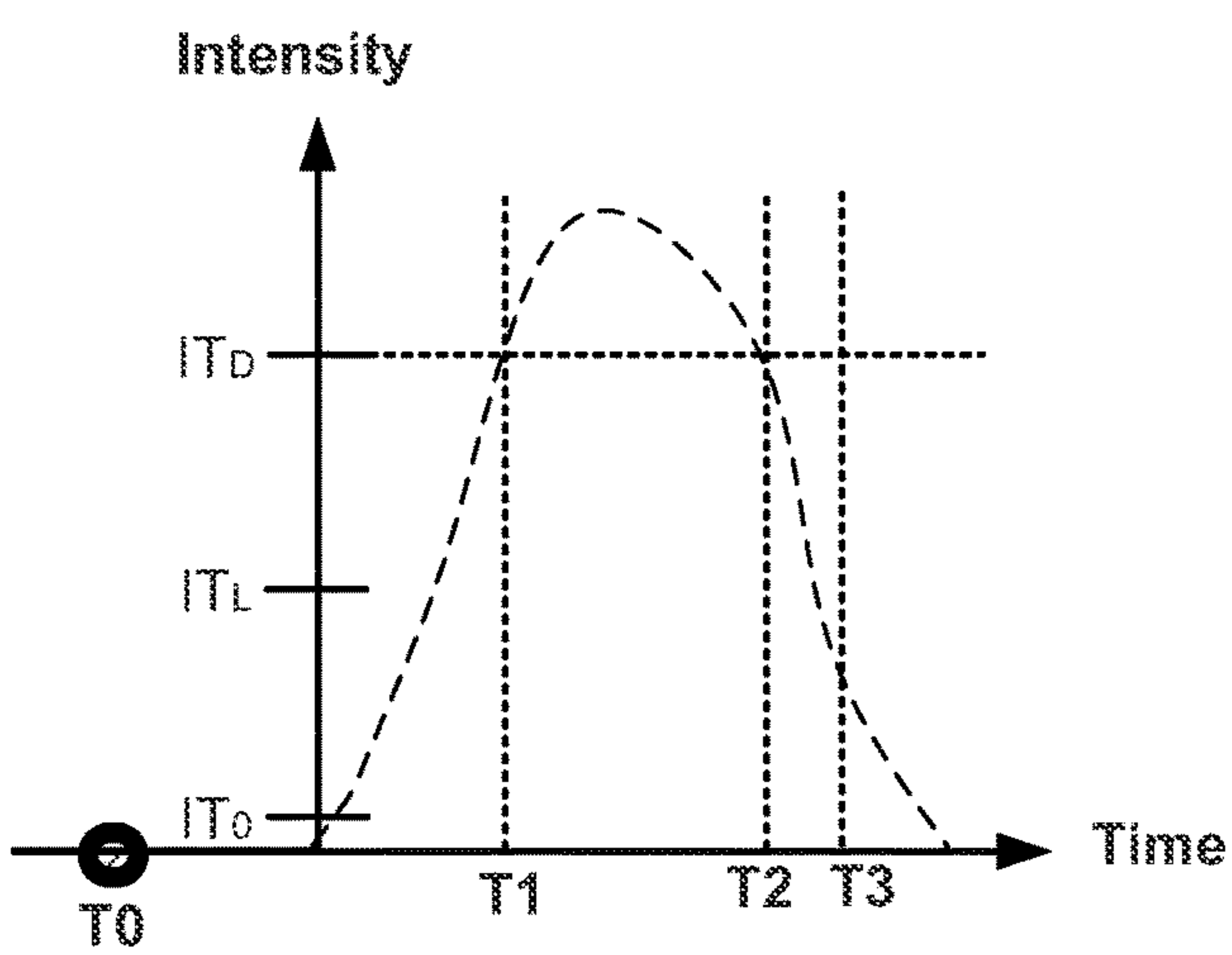
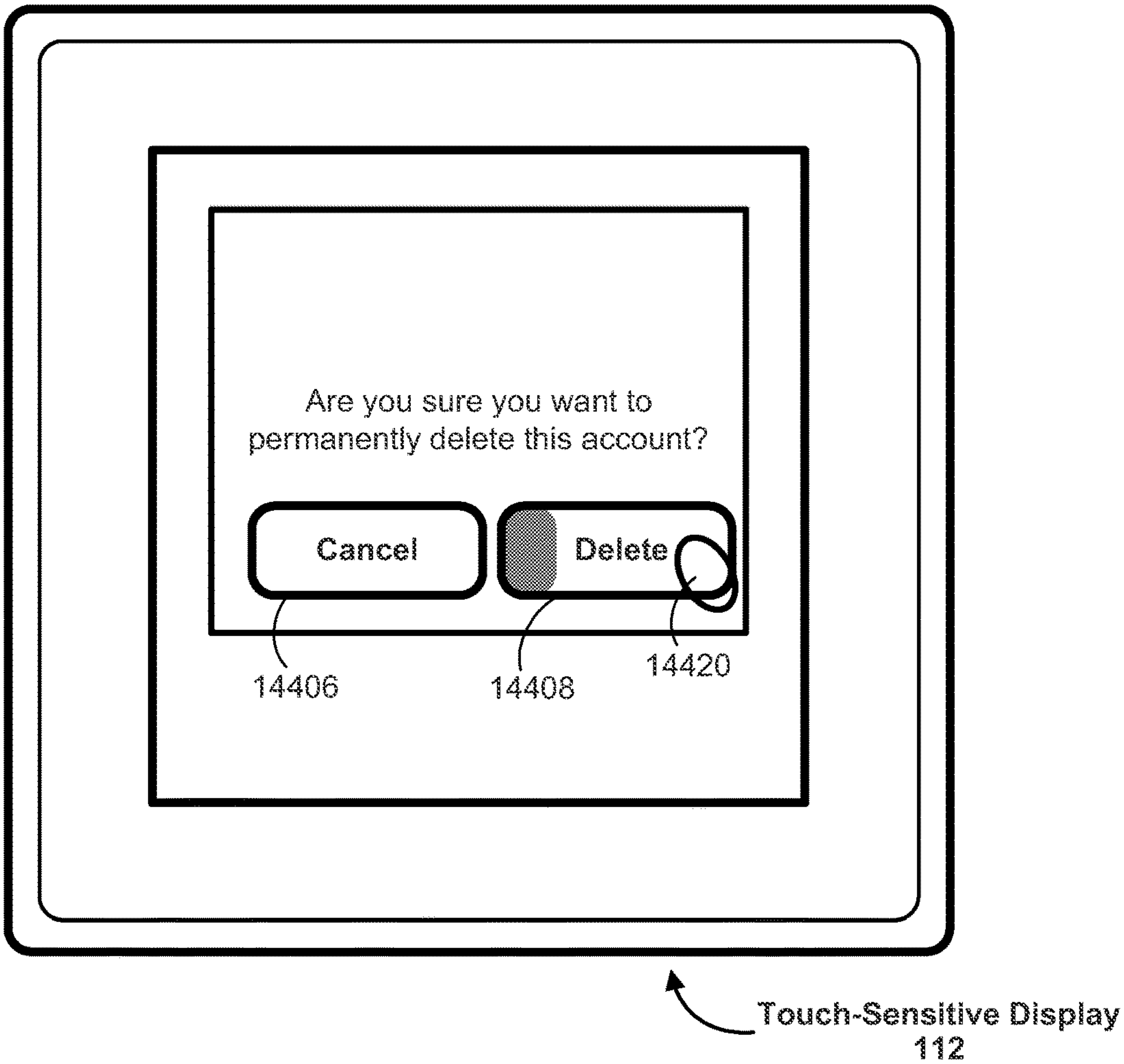
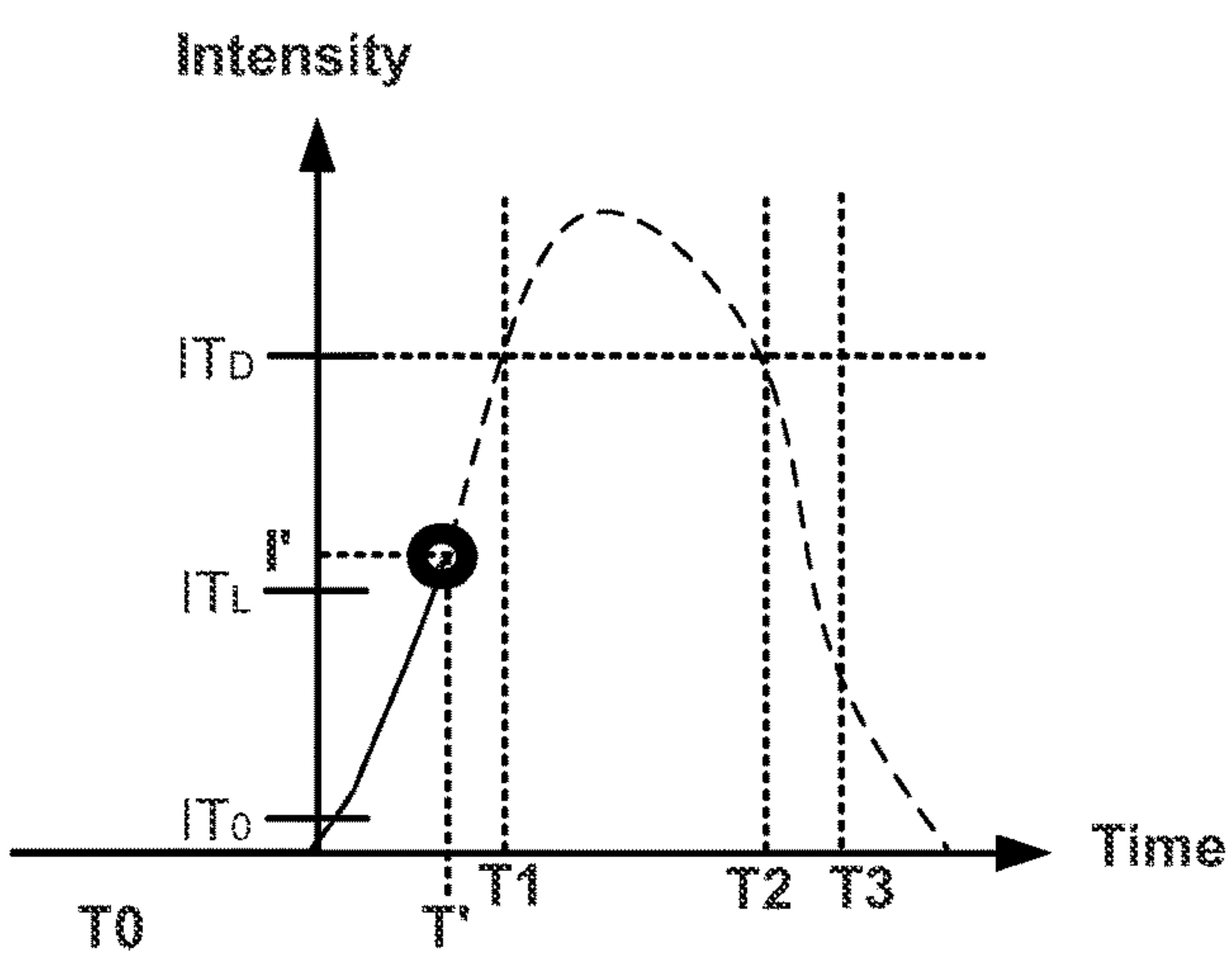

Intensity
ITD
ITL
IT0
T0
T1
T2
T3
Time

Figure 5I

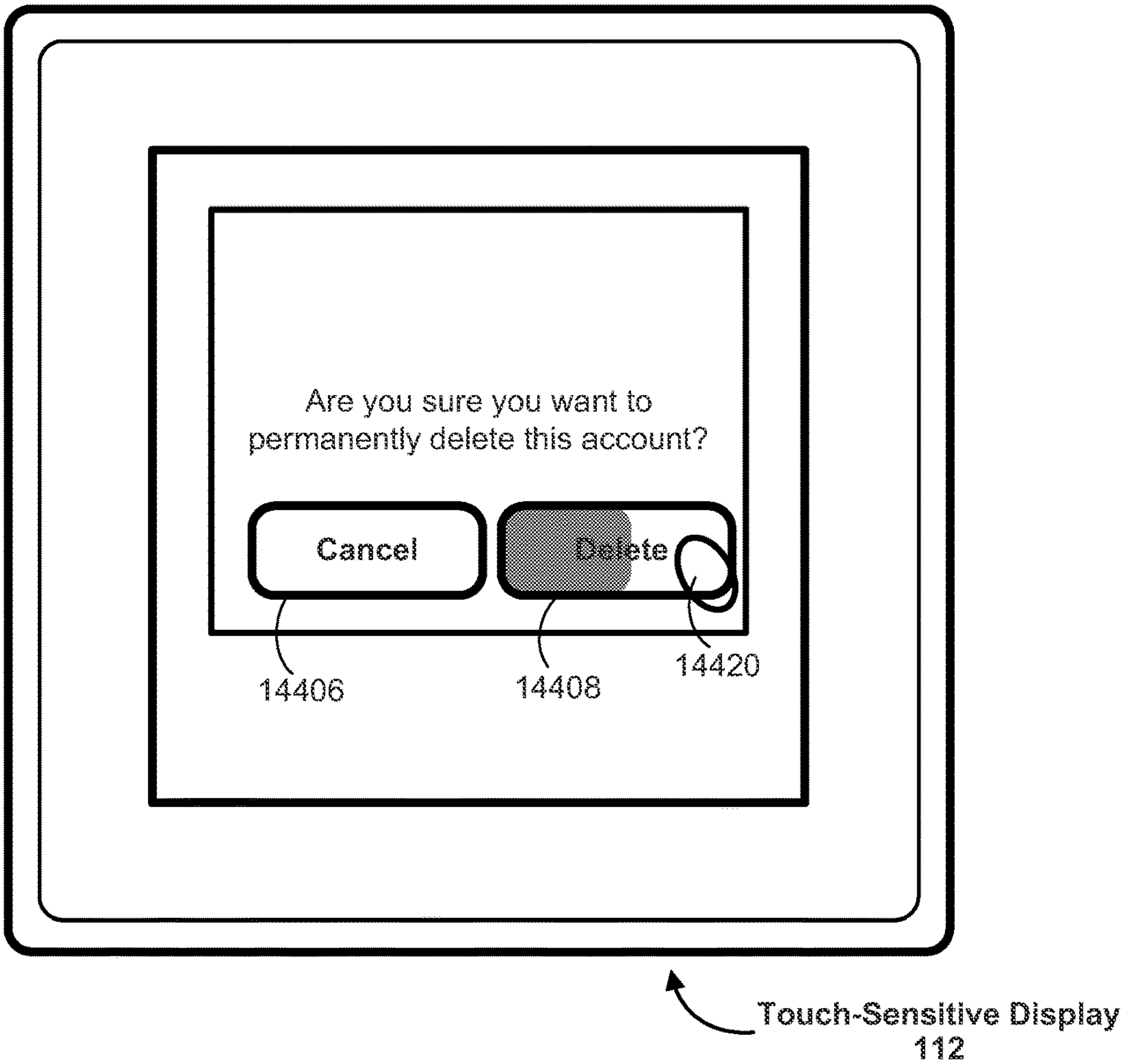


Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14420
Touch-Sensitive Display 112



Intensity
ITD
I'
ITL
IT0
Time
T0
T'
T1
T2
T3

Figure 5J


Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14420
Touch-Sensitive Display 112

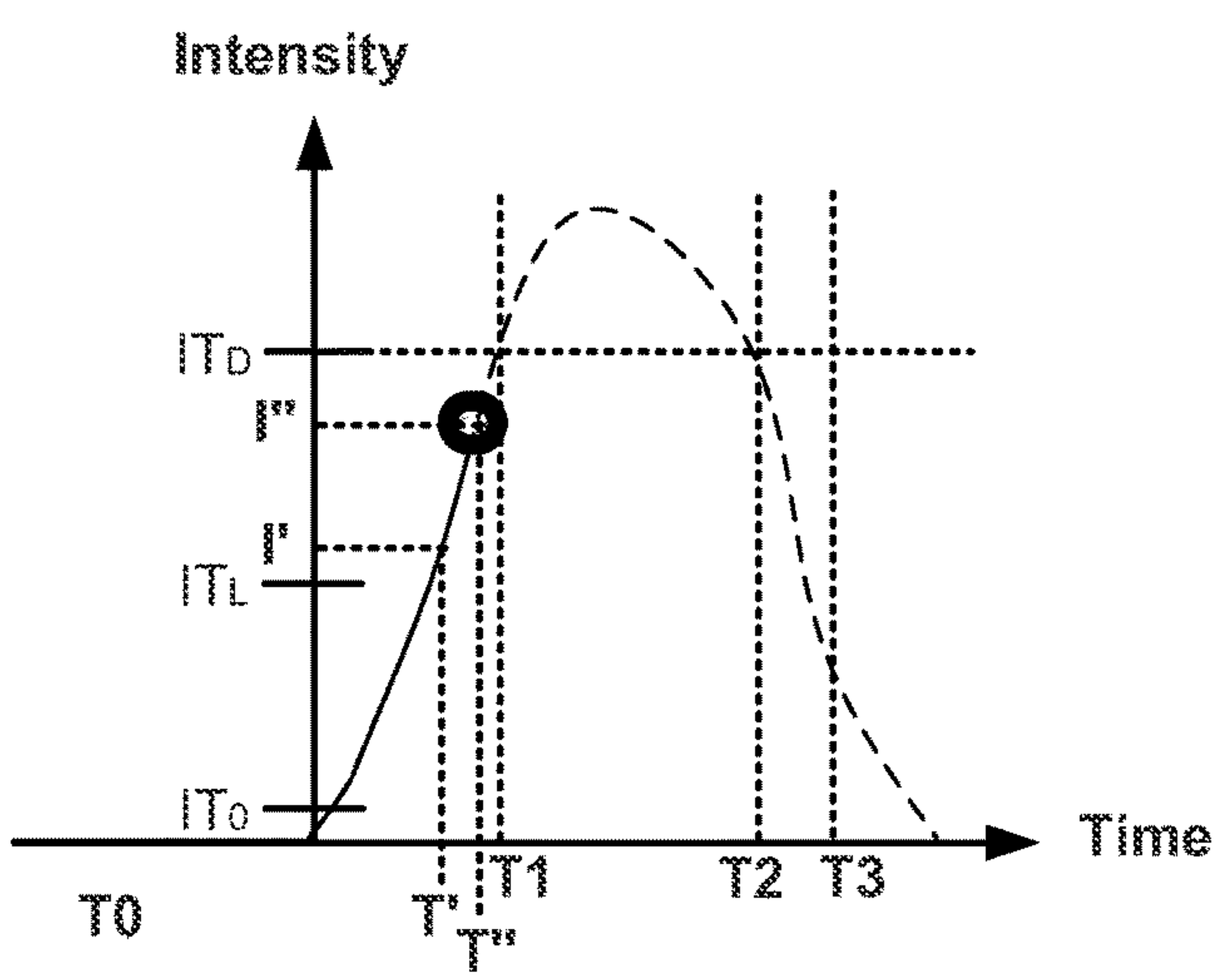
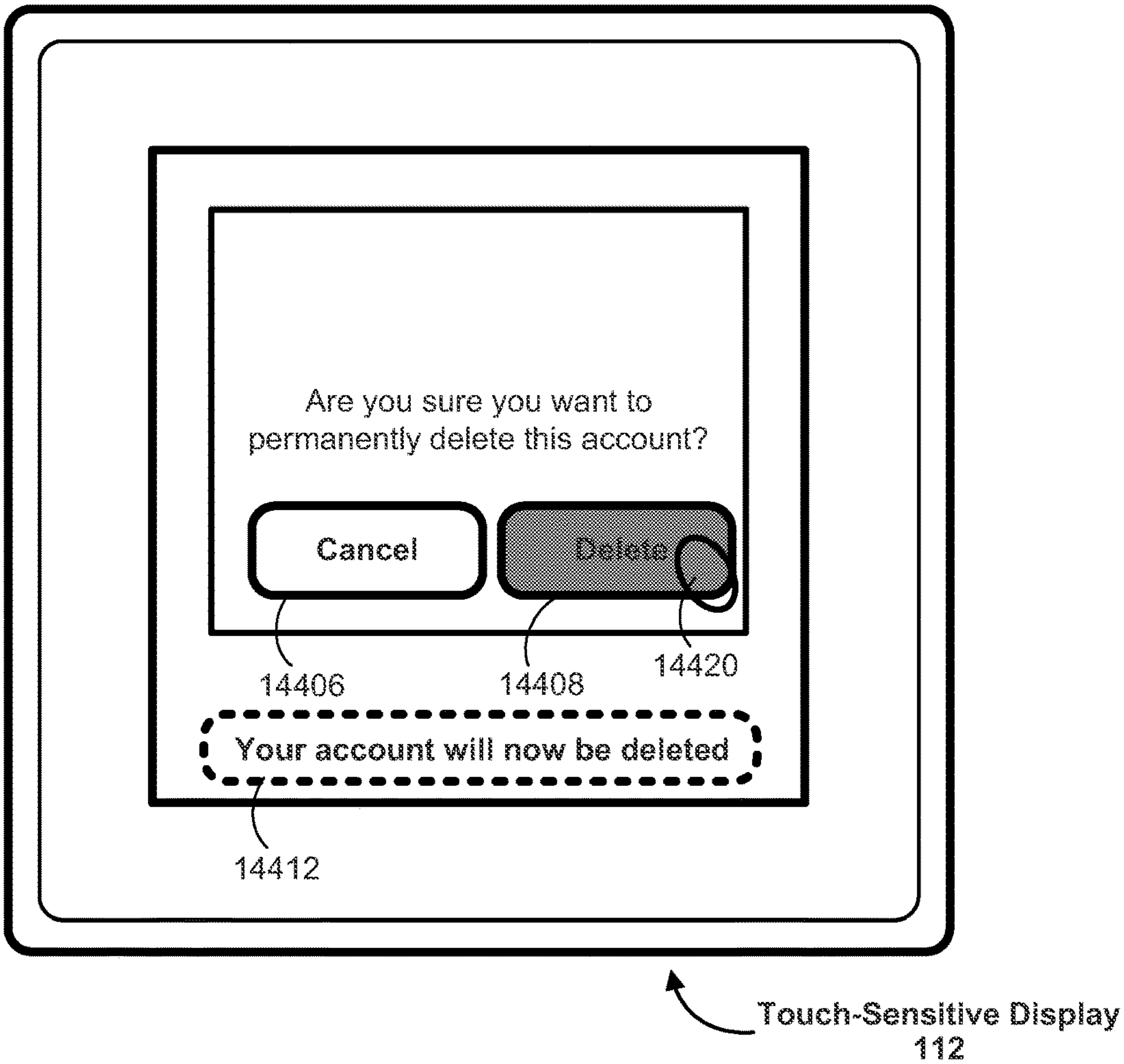

Intensity
ITD
I''
I'
ITL
IT0
Time
T0
T'
T''
T1
T2
T3

Figure 5K


Are you sure you want to permanently delete this account?
Cancel
Delete
14406
14408
14420
Your account will now be deleted
14412
Touch-Sensitive Display 112

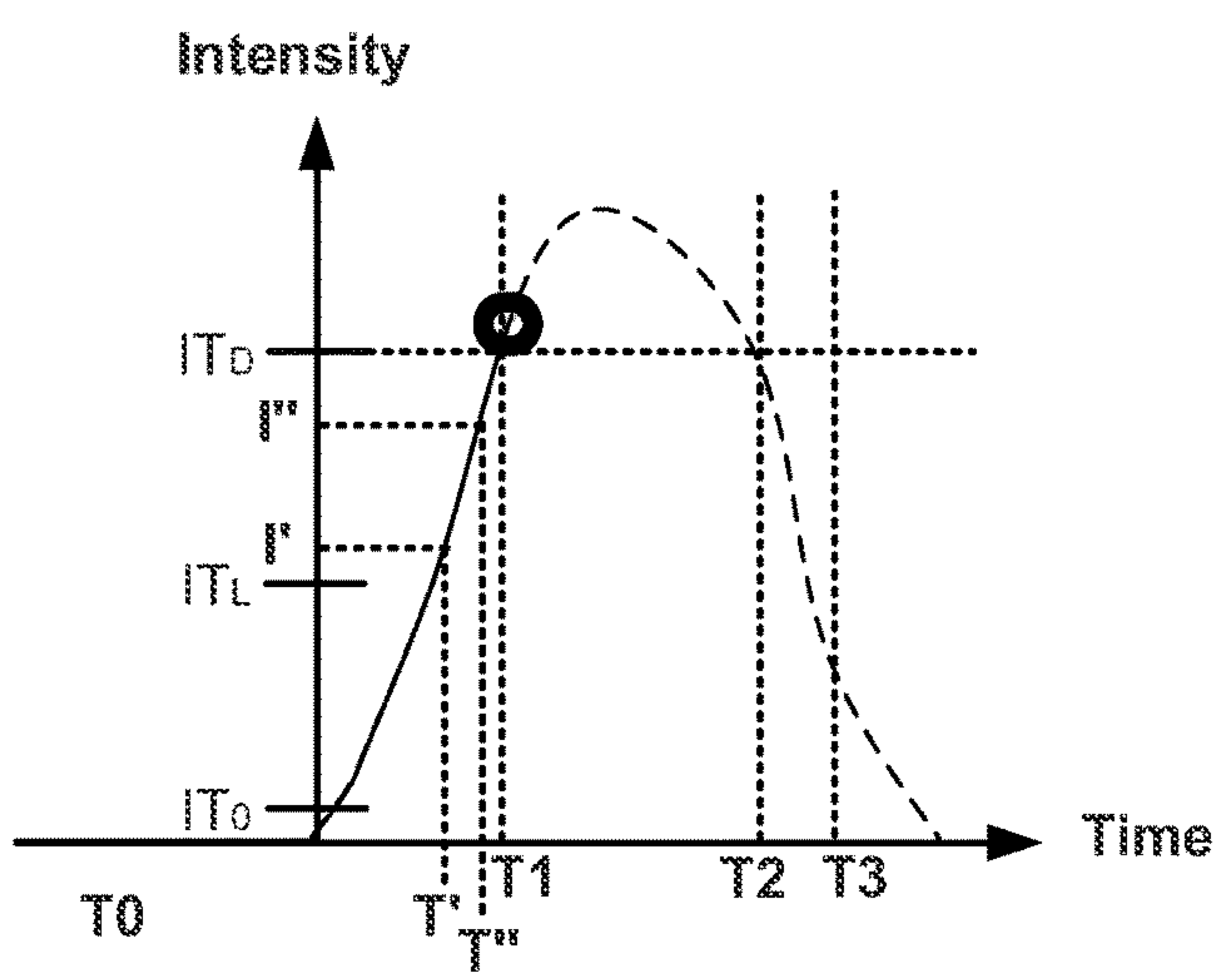
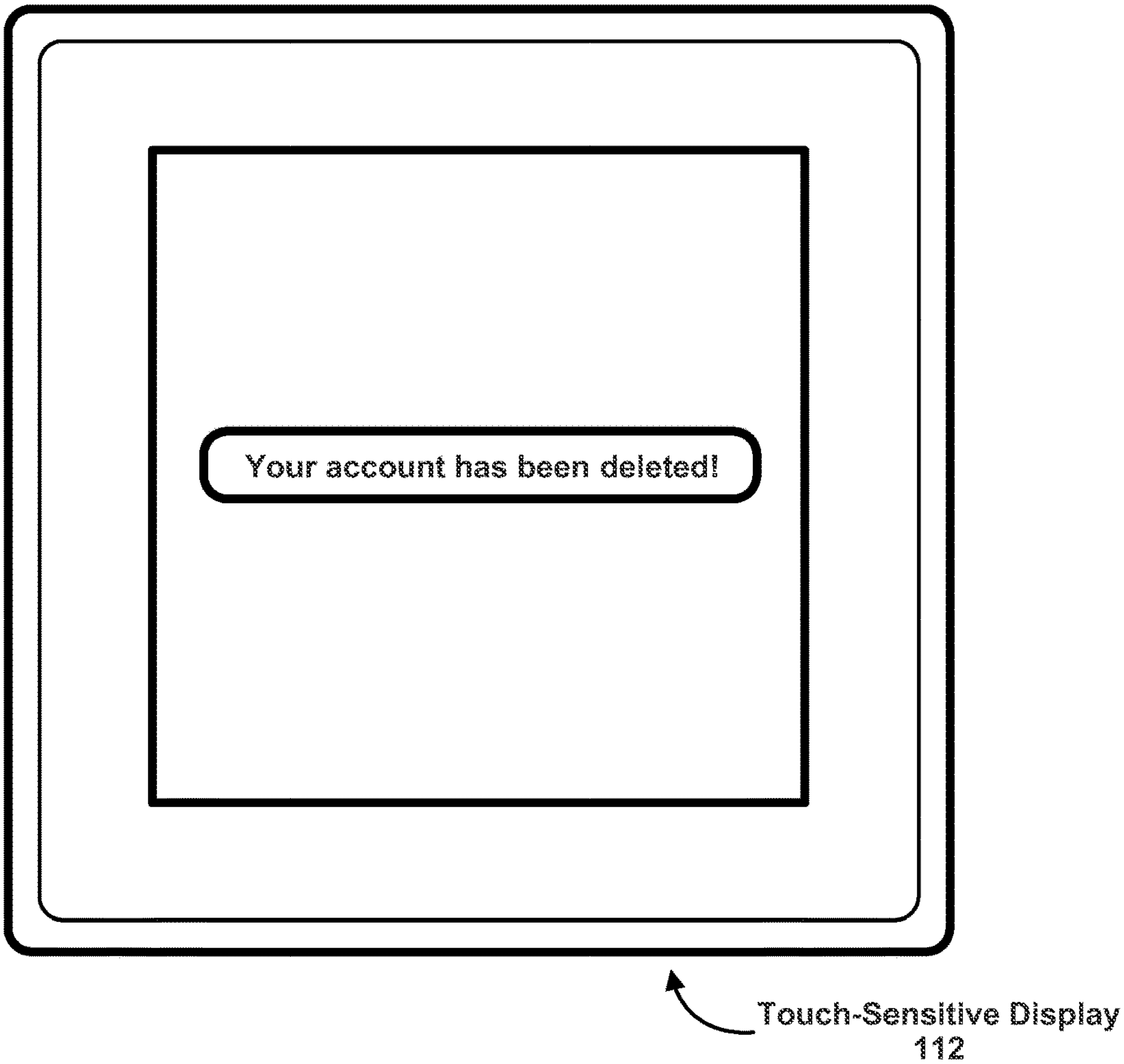

Intensity
ITD
I"
I'
ITL
IT0
Time
T0
T'
T"
T1
T2
T3

Figure 5L


Your account has been deleted!
Touch-Sensitive Display 112

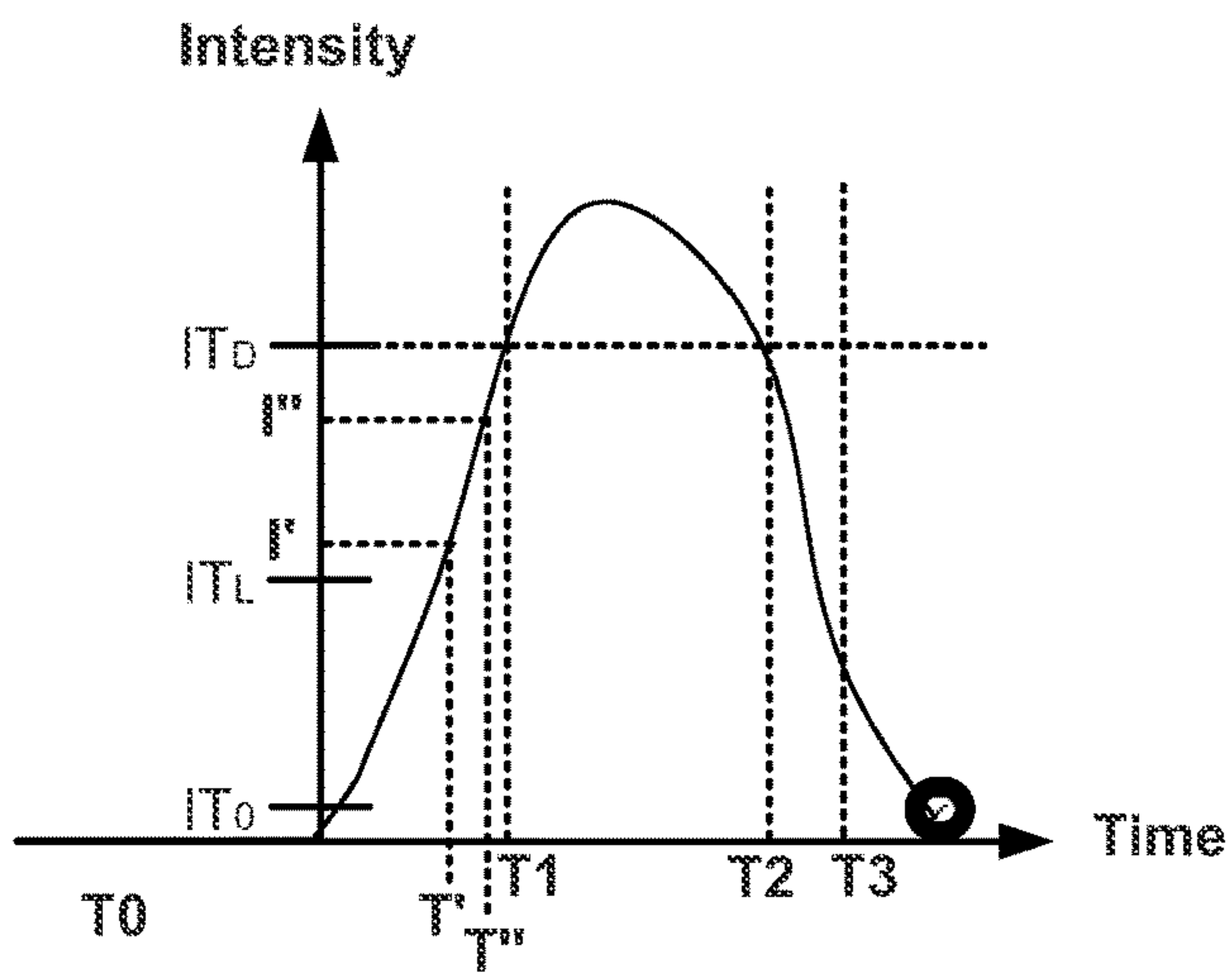

Intensity
ITD
I"
I'
ITL
IT0
Time
T0
T'
T"
T1
T2
T3

Figure 5M

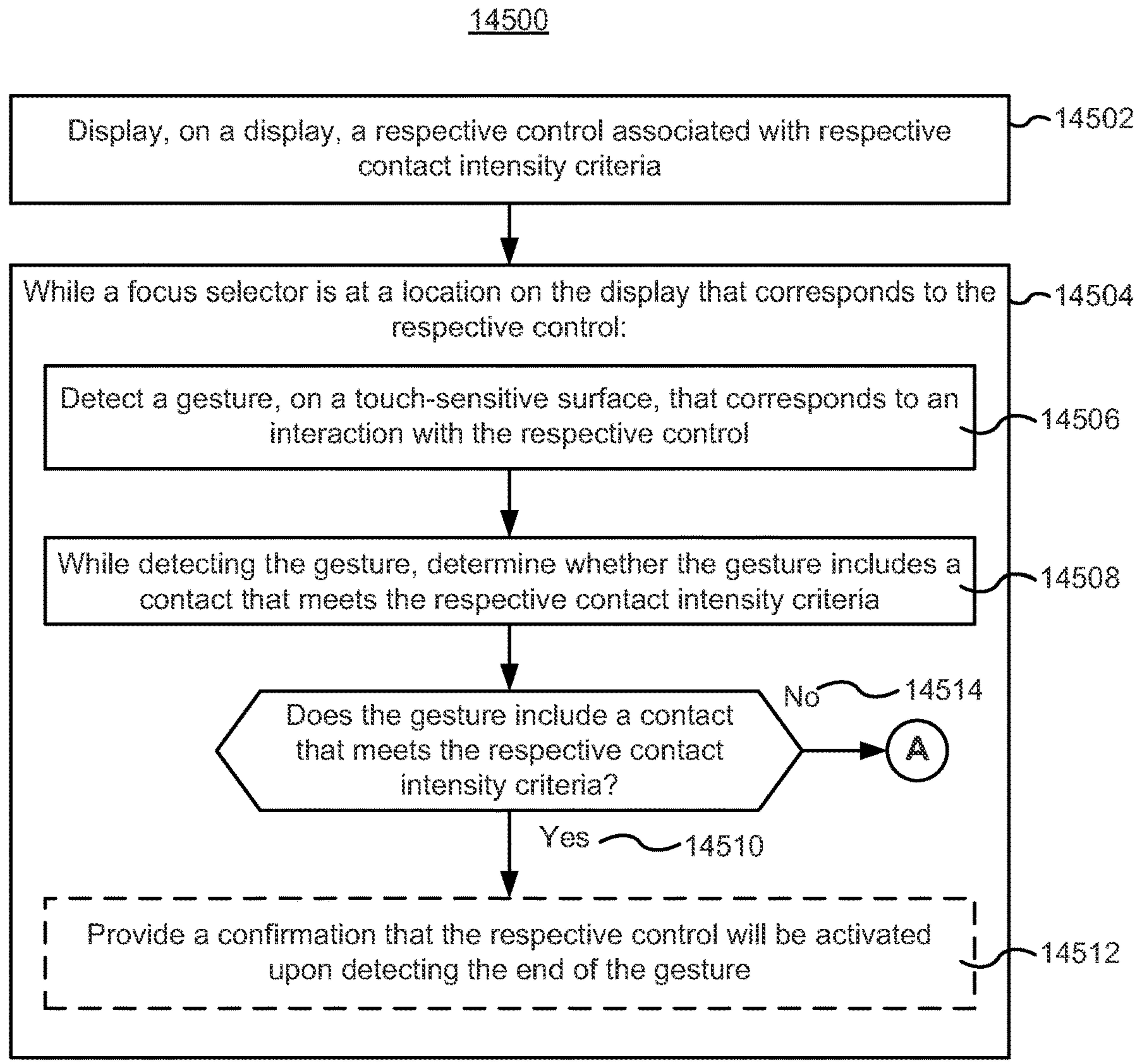

14500
Display, on a display, a respective control associated with respective contact intensity criteria
14502
While a focus selector is at a location on the display that corresponds to the respective control:
14504
Detect a gesture, on a touch-sensitive surface, that corresponds to an interaction with the respective control
14506
While detecting the gesture, determine whether the gesture includes a contact that meets the respective contact intensity criteria
14508
Does the gesture include a contact that meets the respective contact intensity criteria?
No
14514
A
Yes
14510
Provide a confirmation that the respective control will be activated upon detecting the end of the gesture
14512

Figure 6A

While a focus selector is at a location on the display that corresponds to the respective control: 14504

(A)

Change the appearance of the respective control to indicate progress toward meeting the respective contact intensity criteria 14516

The respective contact intensity criteria include a respective contact intensity threshold and a respective delay time period

Changing the appearance of the control includes displaying an indication of an amount of time remaining before the respective delay time period has elapsed 14518

The respective contact intensity criteria include a respective contact intensity threshold

Changing the appearance of the control includes displaying an indication of a difference between a current intensity of a contact on the touch-sensitive surface and the respective contact intensity threshold 14520

Changing the appearance of the control includes displaying a progress bar in the control 14522

Changing the appearance of the control includes changing color of at least a portion of the control in accordance with the intensity of the contact 14524

Changing the appearance of the control includes changing color of at least a portion of the control in accordance with a length of time that the contact has continuously met a respective contact intensity threshold 14526

Changing the appearance of the control includes changing color of at least a portion of the control in accordance with a length of time since the contact met a respective contact intensity threshold 14528

(B)

Figure 6B

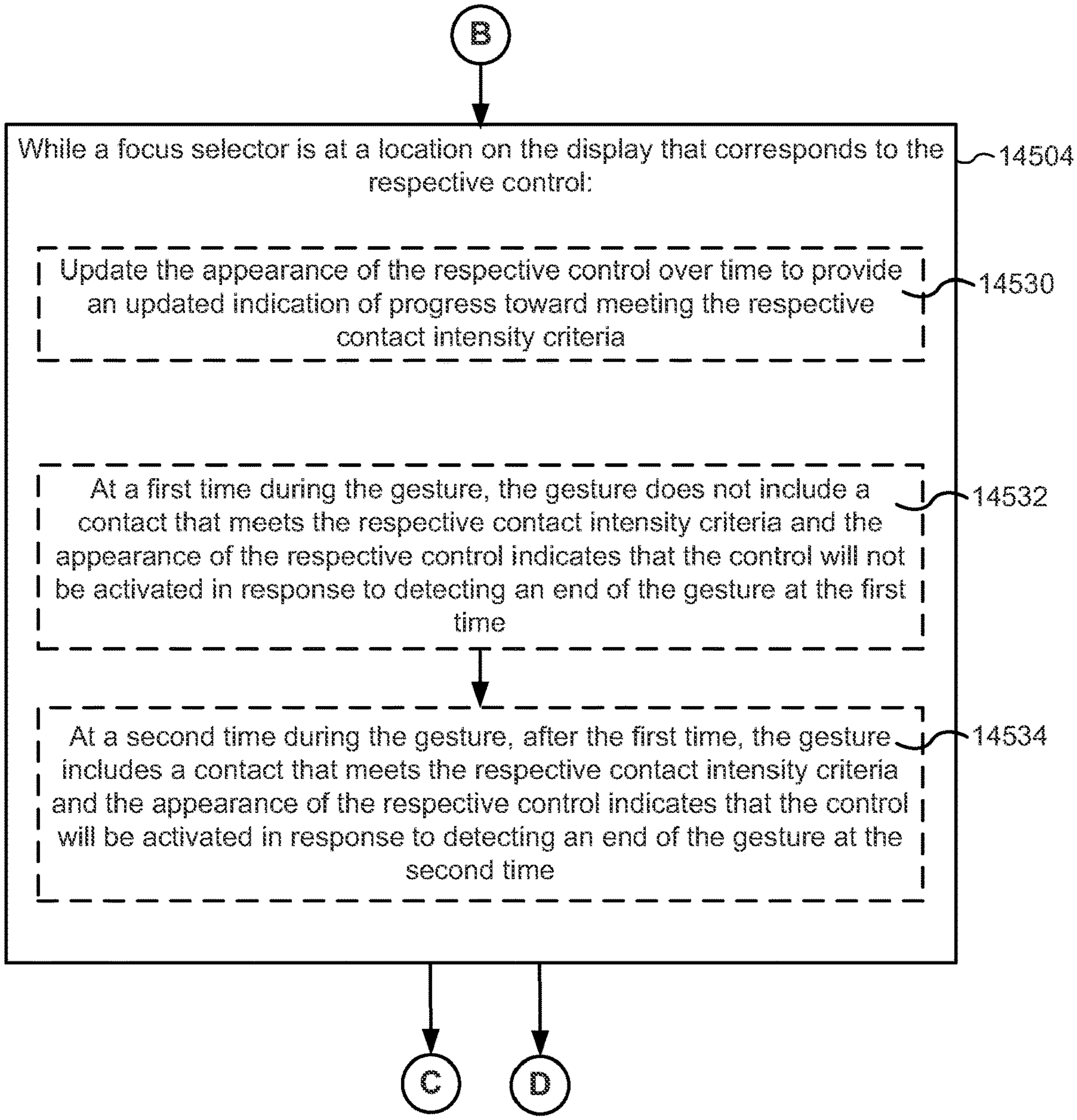

B
While a focus selector is at a location on the display that corresponds to the respective control:
14504
Update the appearance of the respective control over time to provide an updated indication of progress toward meeting the respective contact intensity criteria
14530
At a first time during the gesture, the gesture does not include a contact that meets the respective contact intensity criteria and the appearance of the respective control indicates that the control will not be activated in response to detecting an end of the gesture at the first time
14532
At a second time during the gesture, after the first time, the gesture includes a contact that meets the respective contact intensity criteria and the appearance of the respective control indicates that the control will be activated in response to detecting an end of the gesture at the second time
14534
C
D

Figure 6C

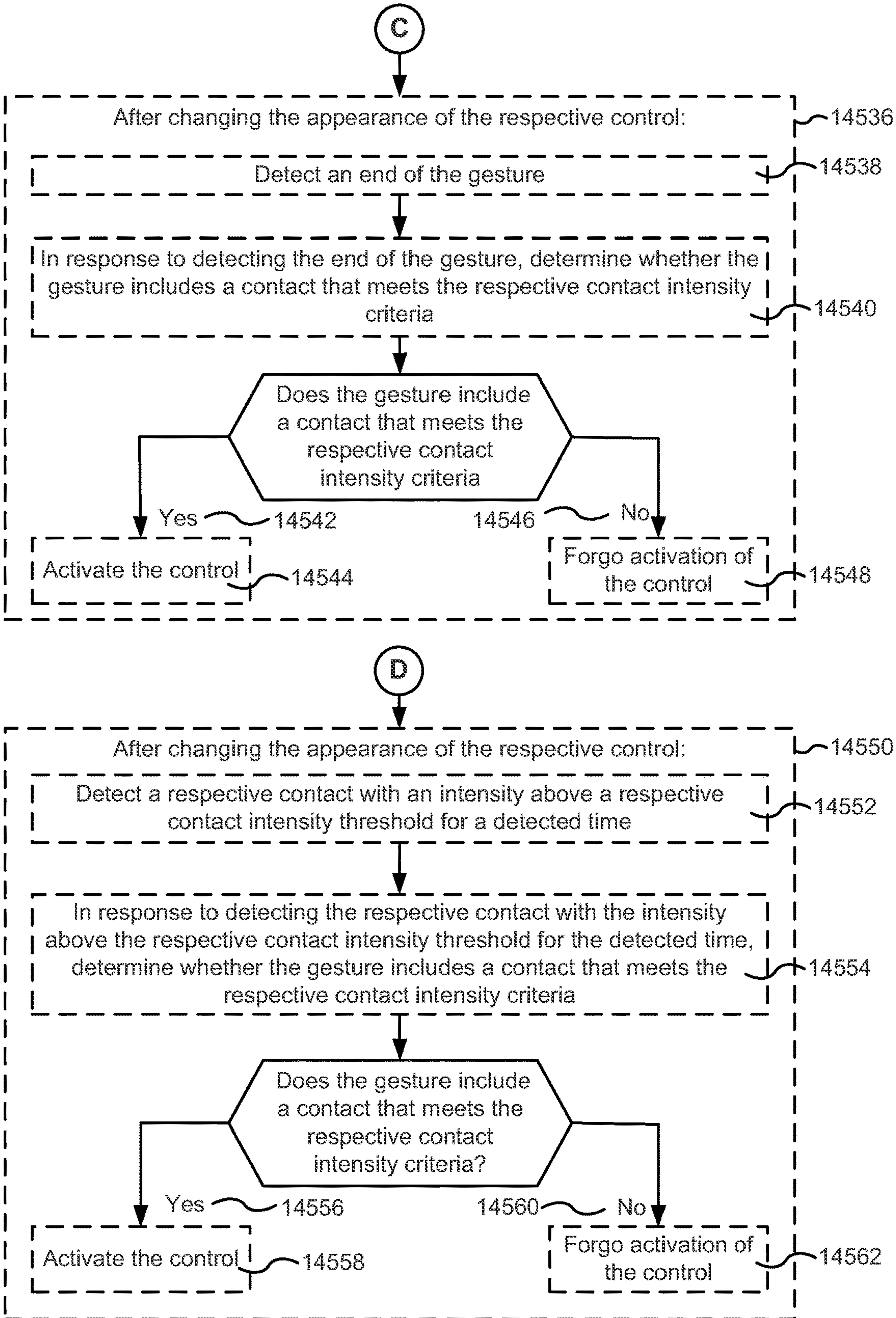

C
After changing the appearance of the respective control:
14536
Detect an end of the gesture
14538
In response to detecting the end of the gesture, determine whether the gesture includes a contact that meets the respective contact intensity criteria
14540
Does the gesture include a contact that meets the respective contact intensity criteria
Yes
14542
14546
No
Activate the control
14544
Forgo activation of the control
14548
D
After changing the appearance of the respective control:
14550
Detect a respective contact with an intensity above a respective contact intensity threshold for a detected time
14552
In response to detecting the respective contact with the intensity above the respective contact intensity threshold for the detected time, determine whether the gesture includes a contact that meets the respective contact intensity criteria
14554
Does the gesture include a contact that meets the respective contact intensity criteria?
Yes
14556
14560
No
Activate the control
14558
Forgo activation of the control
14562

Figure 6D

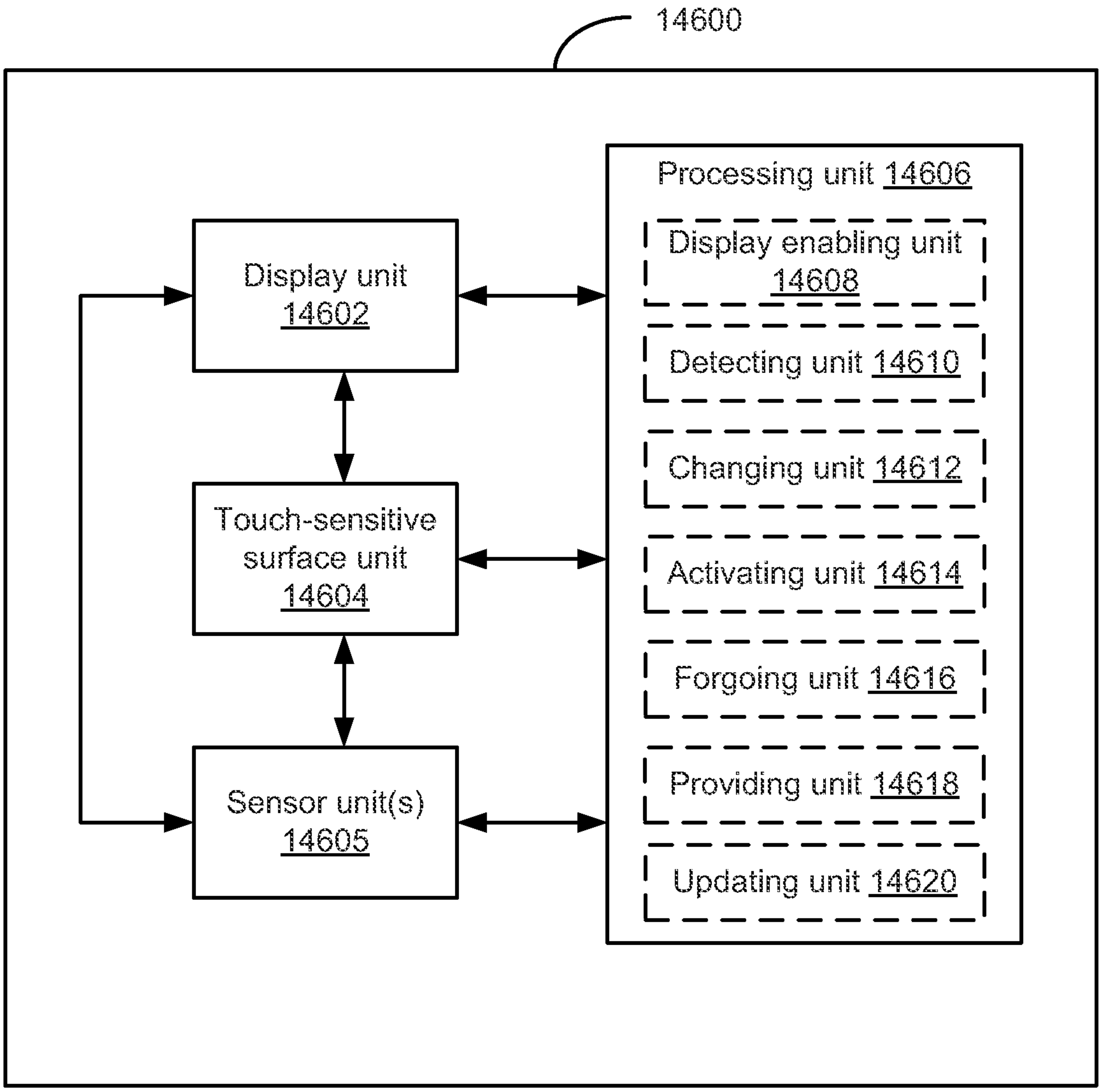

14600
Processing unit 14606
Display enabling unit 14608
Detecting unit 14610
Changing unit 14612
Activating unit 14614
Forgoing unit 14616
Providing unit 14618
Updating unit 14620
Display unit 14602
Touch-sensitive surface unit 14604
Sensor unit(s) 14605

Figure 7

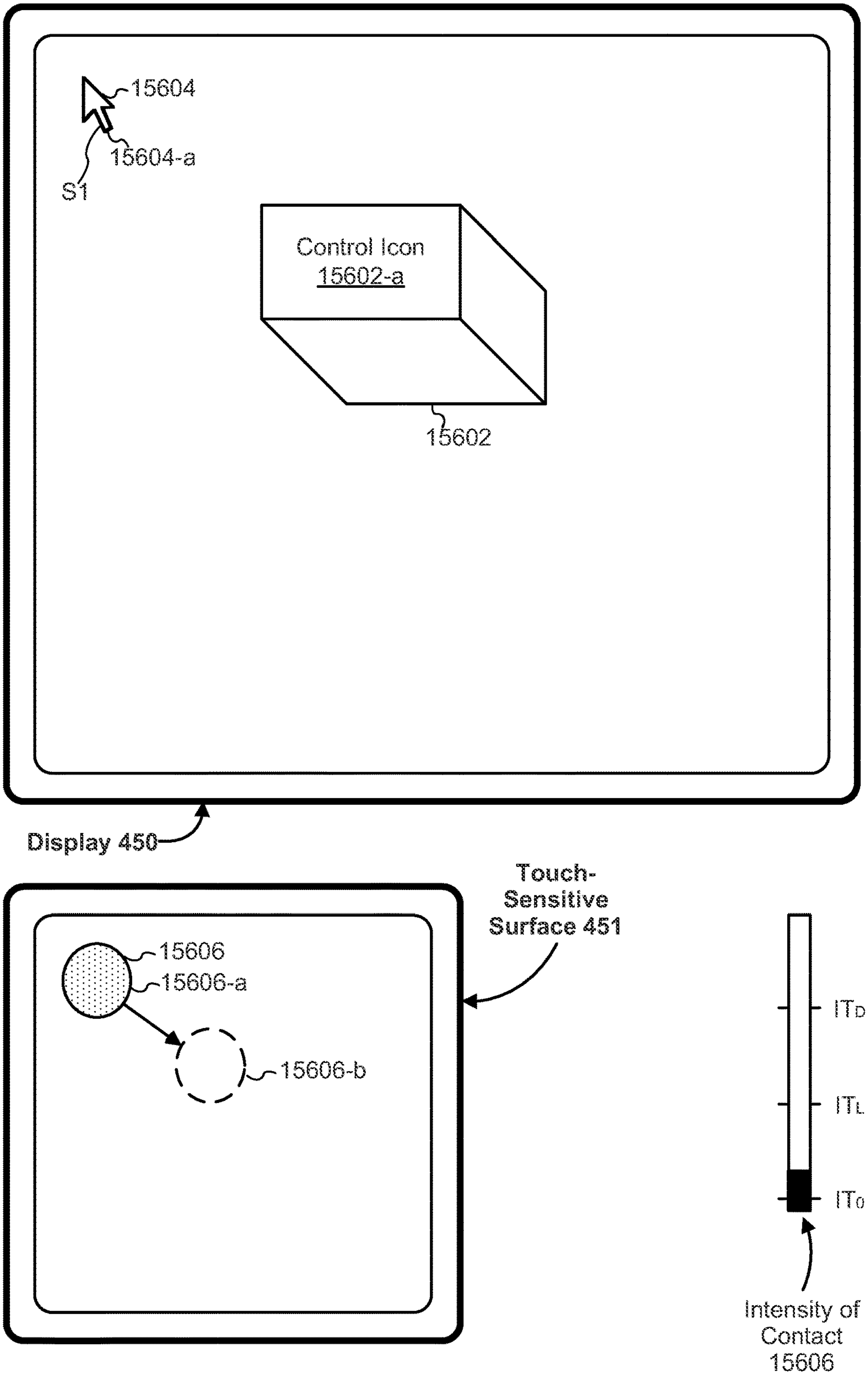

15604
15604-a
S1
Control Icon
15602-a
15602
Display 450
Touch-Sensitive Surface 451
15606
15606-a
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8A

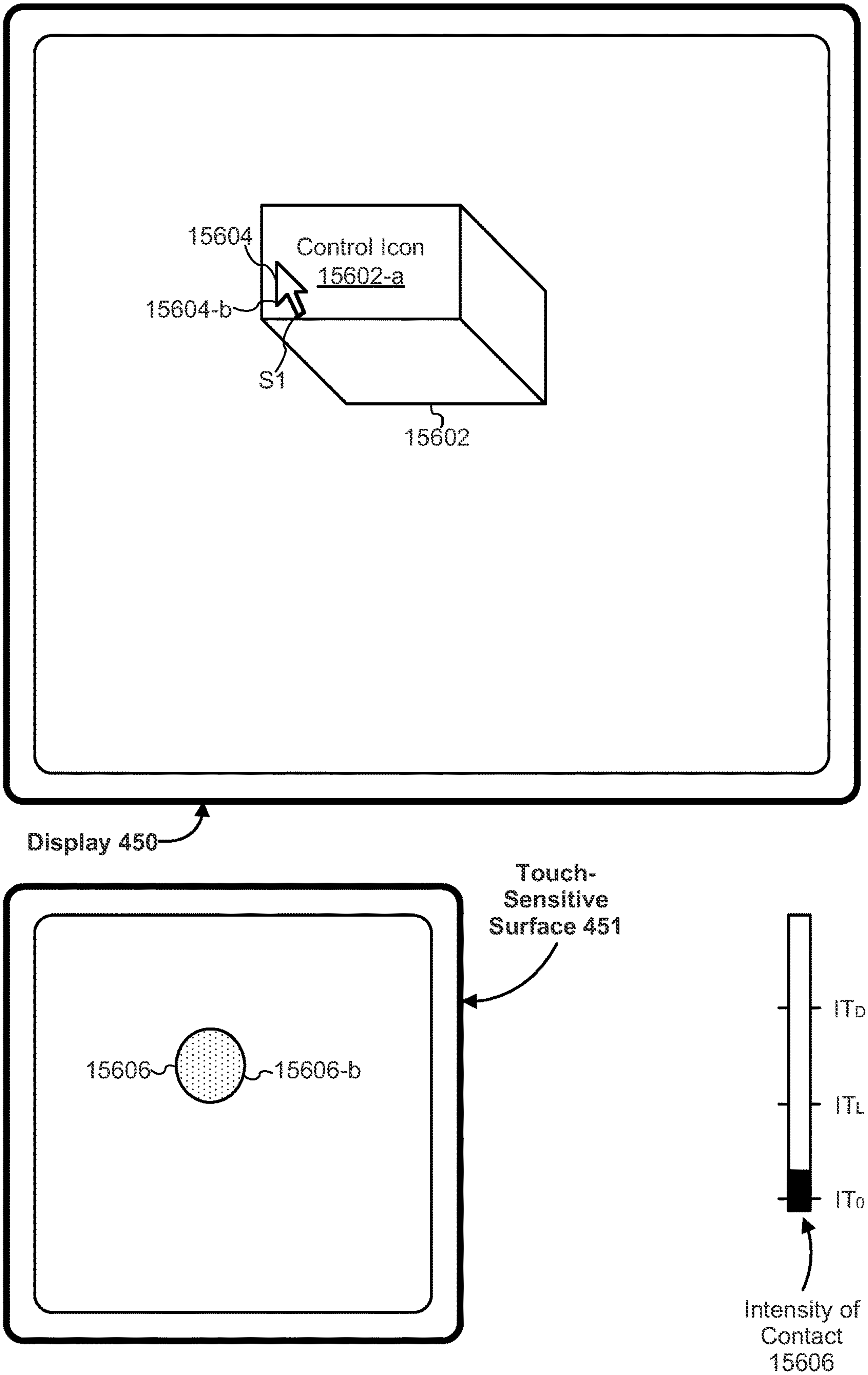
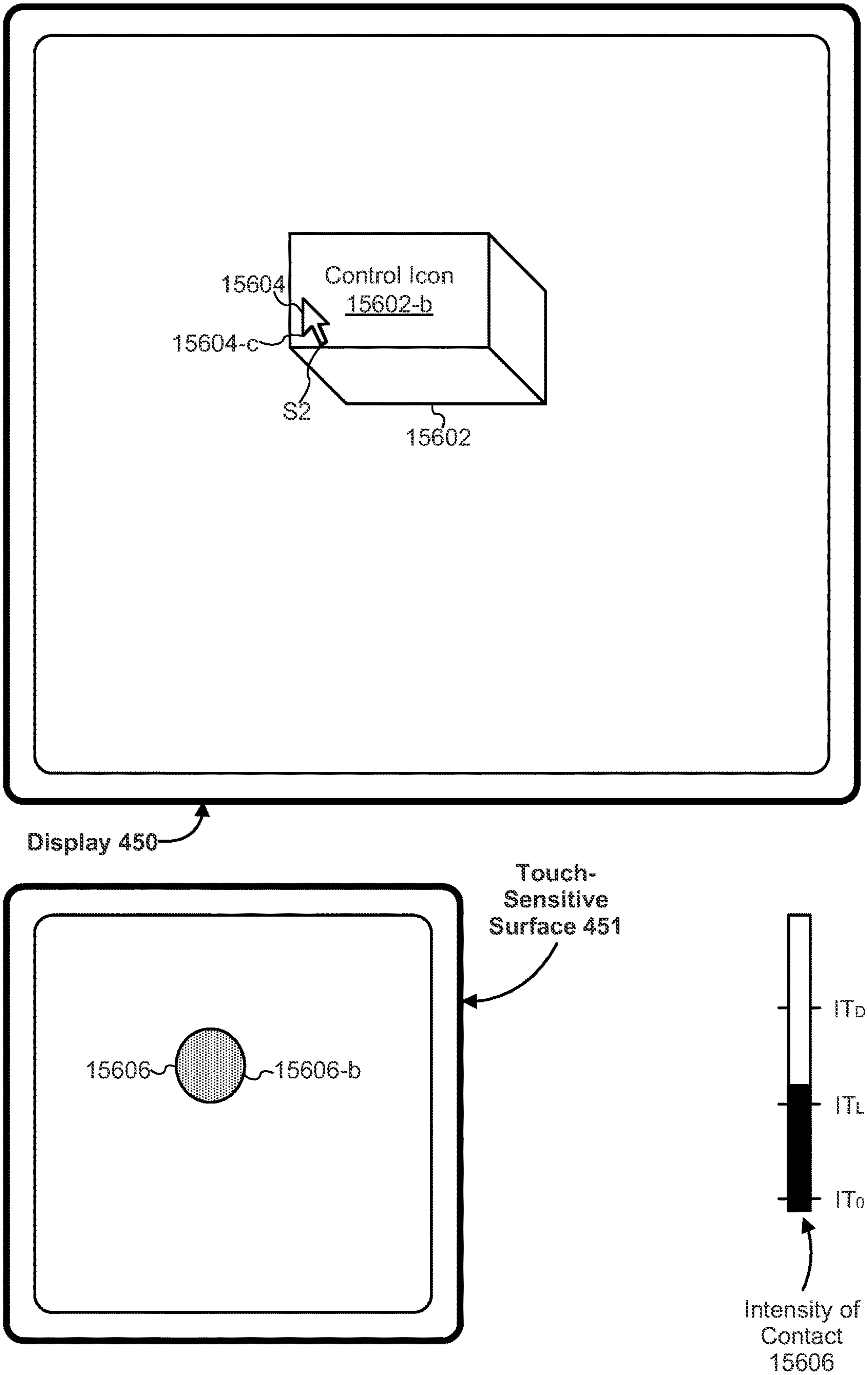

Control Icon
15602-a
15604
15604-b
S1
15602
Display 450
Touch-Sensitive Surface 451
15606
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8B



Control Icon
15602-b
15604
15604-c
S2
15602
Display 450
Touch-Sensitive Surface 451
15606
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8C

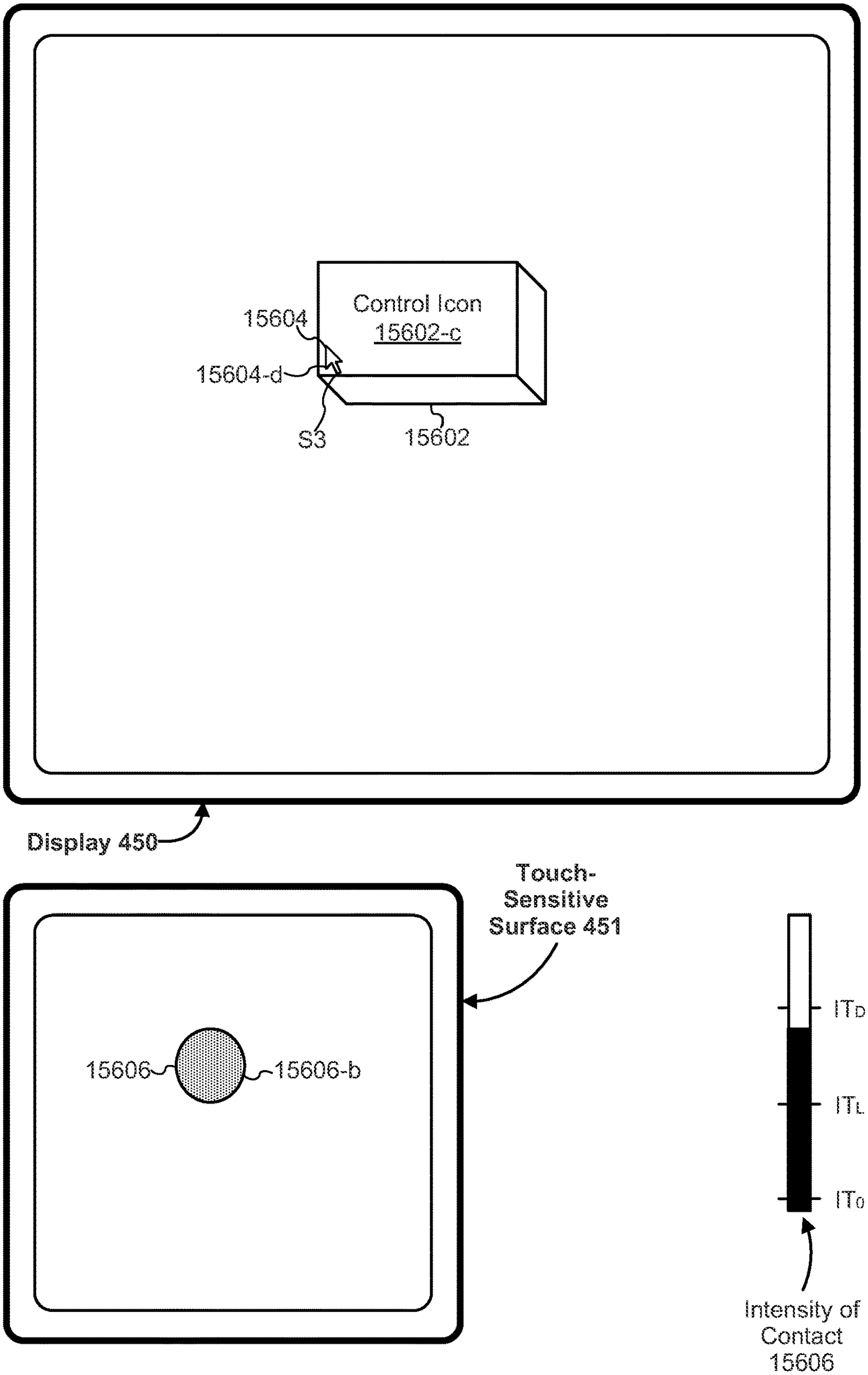
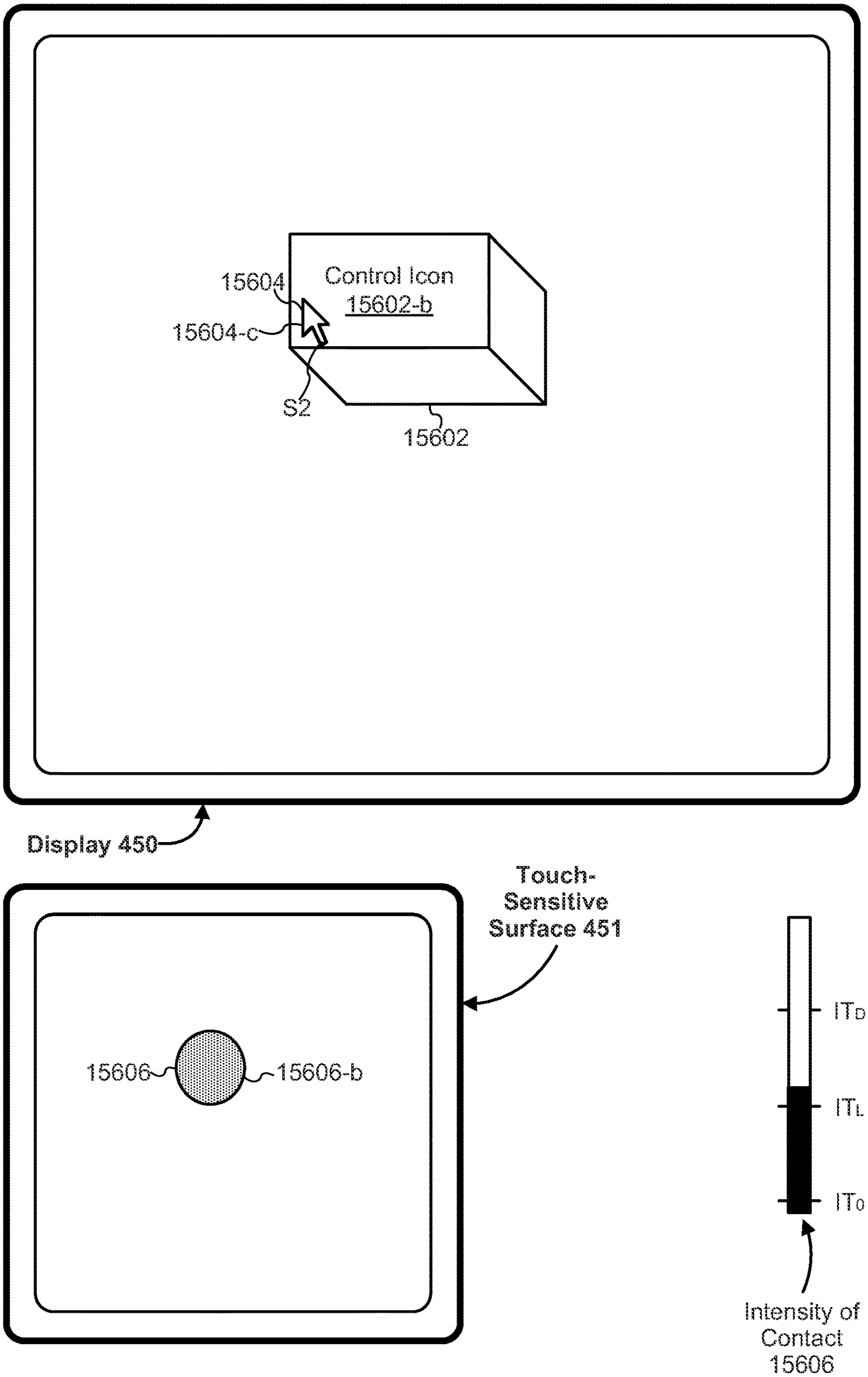

Control Icon
15602-c
15604
15604-d
S3
15602
Display 450
Touch-Sensitive Surface 451
15606
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8D



Control Icon
15602-b
15604
15604-c
S2
15602
Display 450
Touch-Sensitive Surface 451
15606
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8E

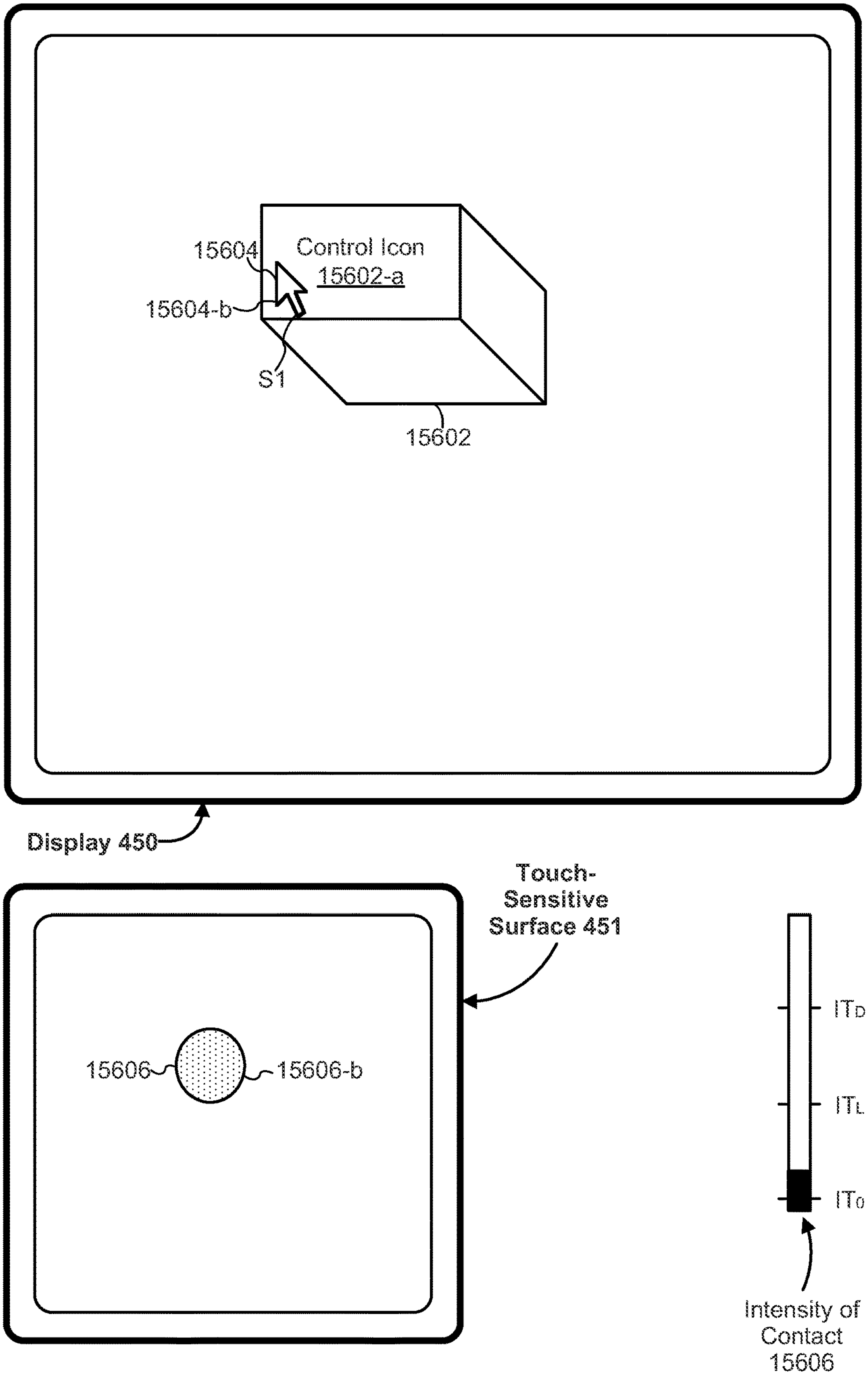
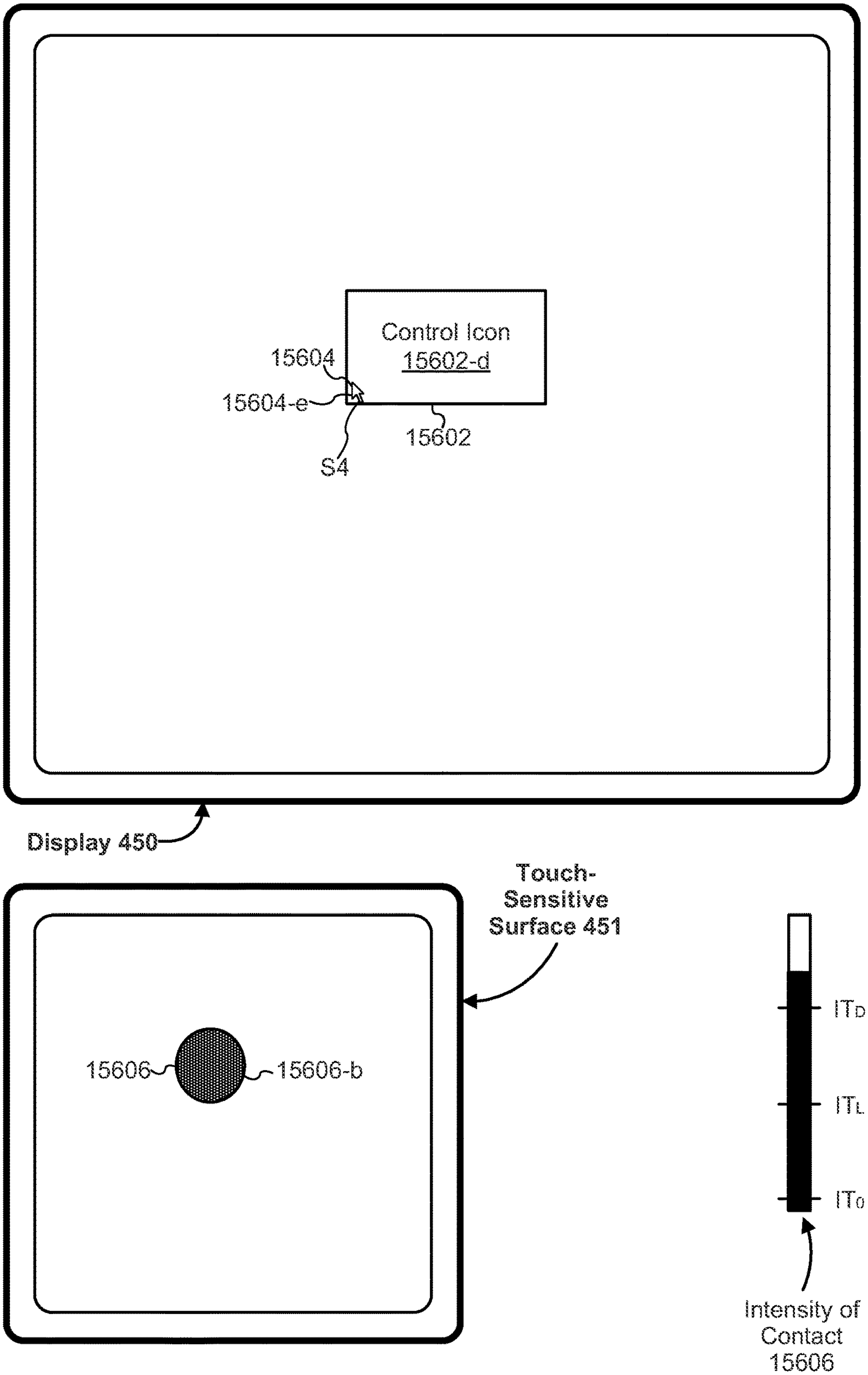

Control Icon
15602-a
15604
15604-b
S1
15602
Display 450
Touch-Sensitive Surface 451
15606
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8F



Control Icon
15602-d
15604
15604-e
15602
S4
Display 450
Touch-Sensitive Surface 451
15606
15606-b
ITD
ITL
IT0
Intensity of Contact 15606

Figure 8G

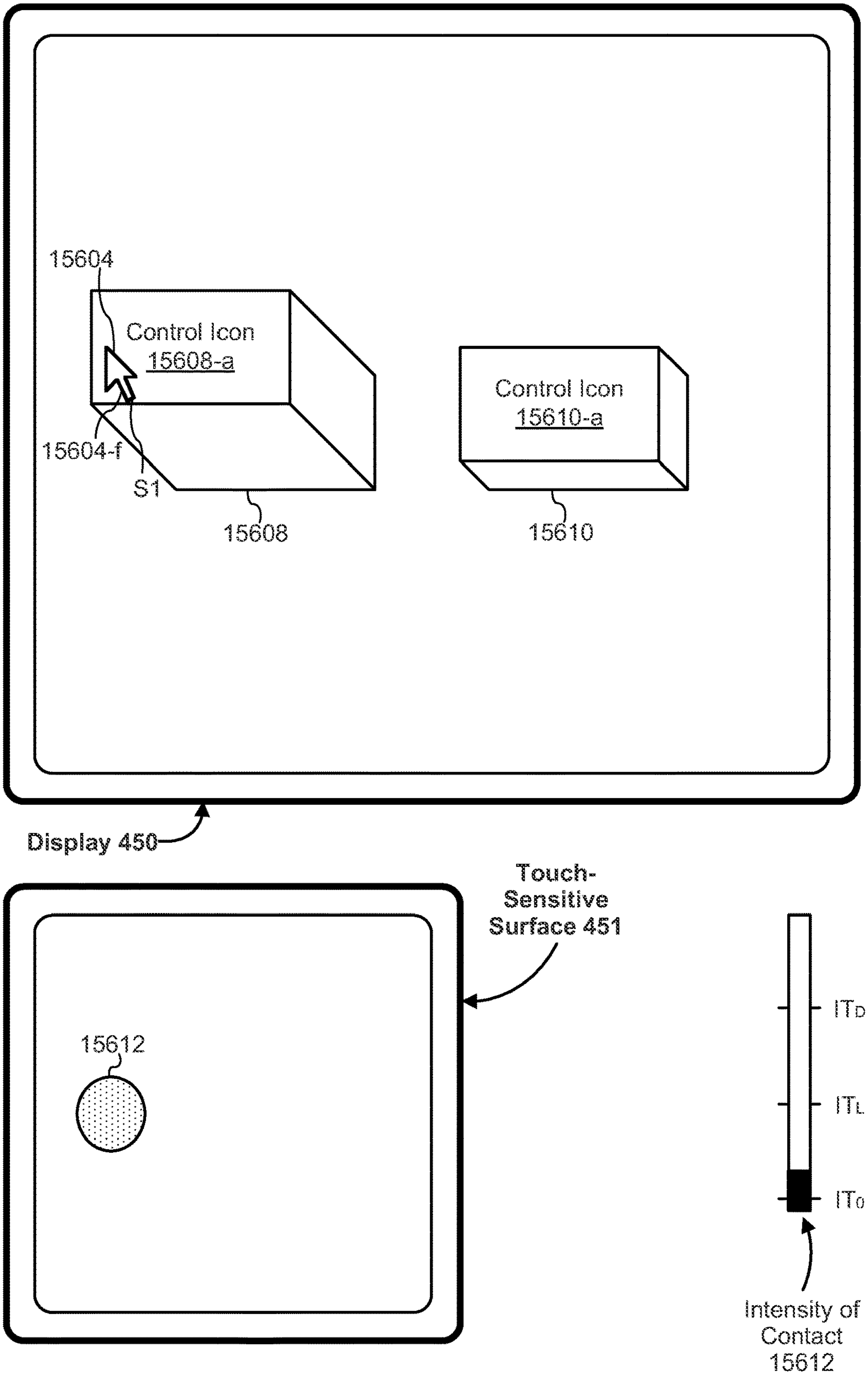
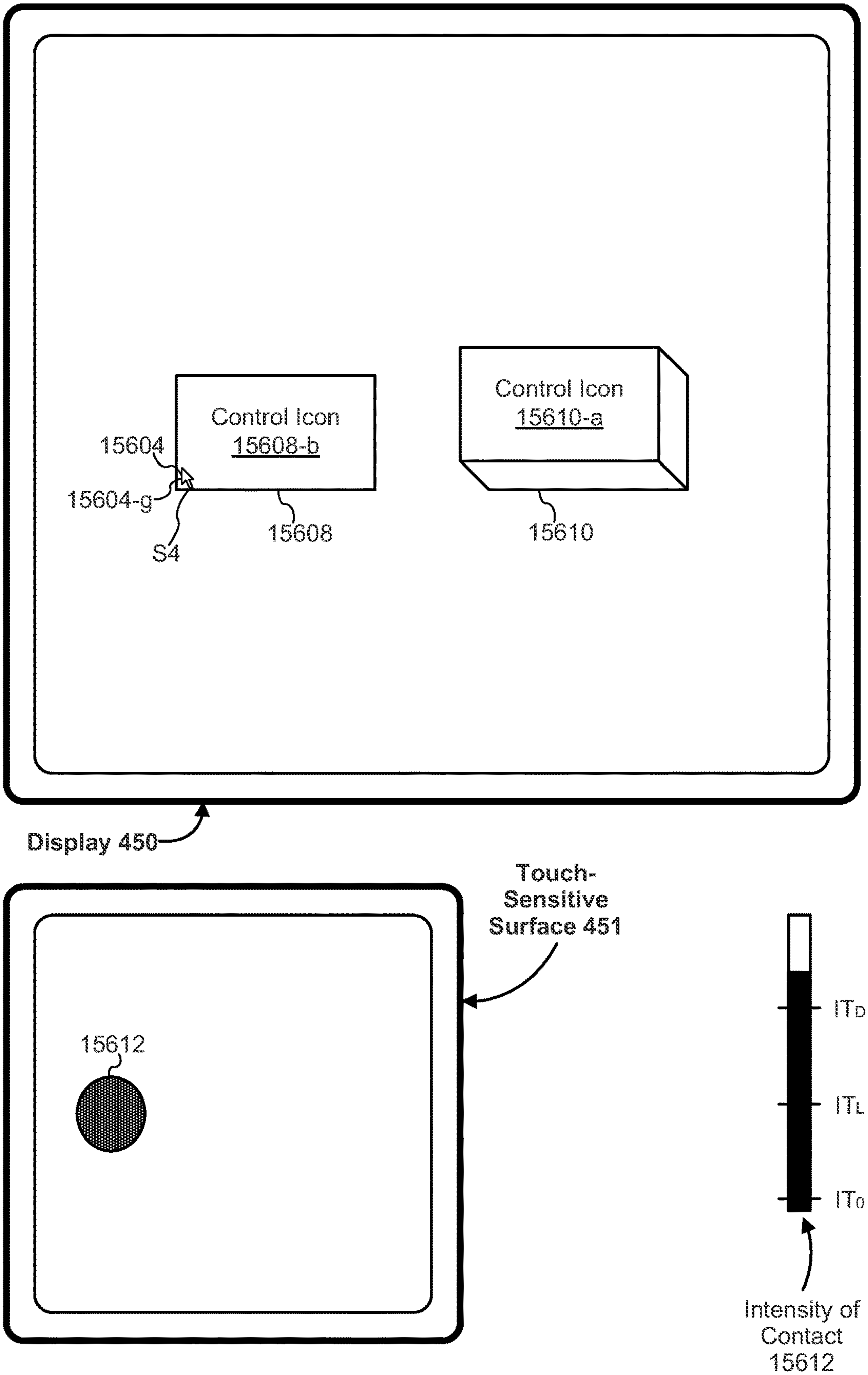

15604
Control Icon
15608-a
15604-f
S1
15608
Control Icon
15610-a
15610
Display 450
Touch-Sensitive Surface 451
15612
IT_D
IT_L
IT_0
Intensity of Contact 15612

Figure 8H



Control Icon
15608-b
Control Icon
15610-a
15604
15604-g
S4
15608
15610
Display 450
Touch-Sensitive Surface 451
15612
IT_D
IT_L
IT_0
Intensity of Contact 15612

Figure 8I

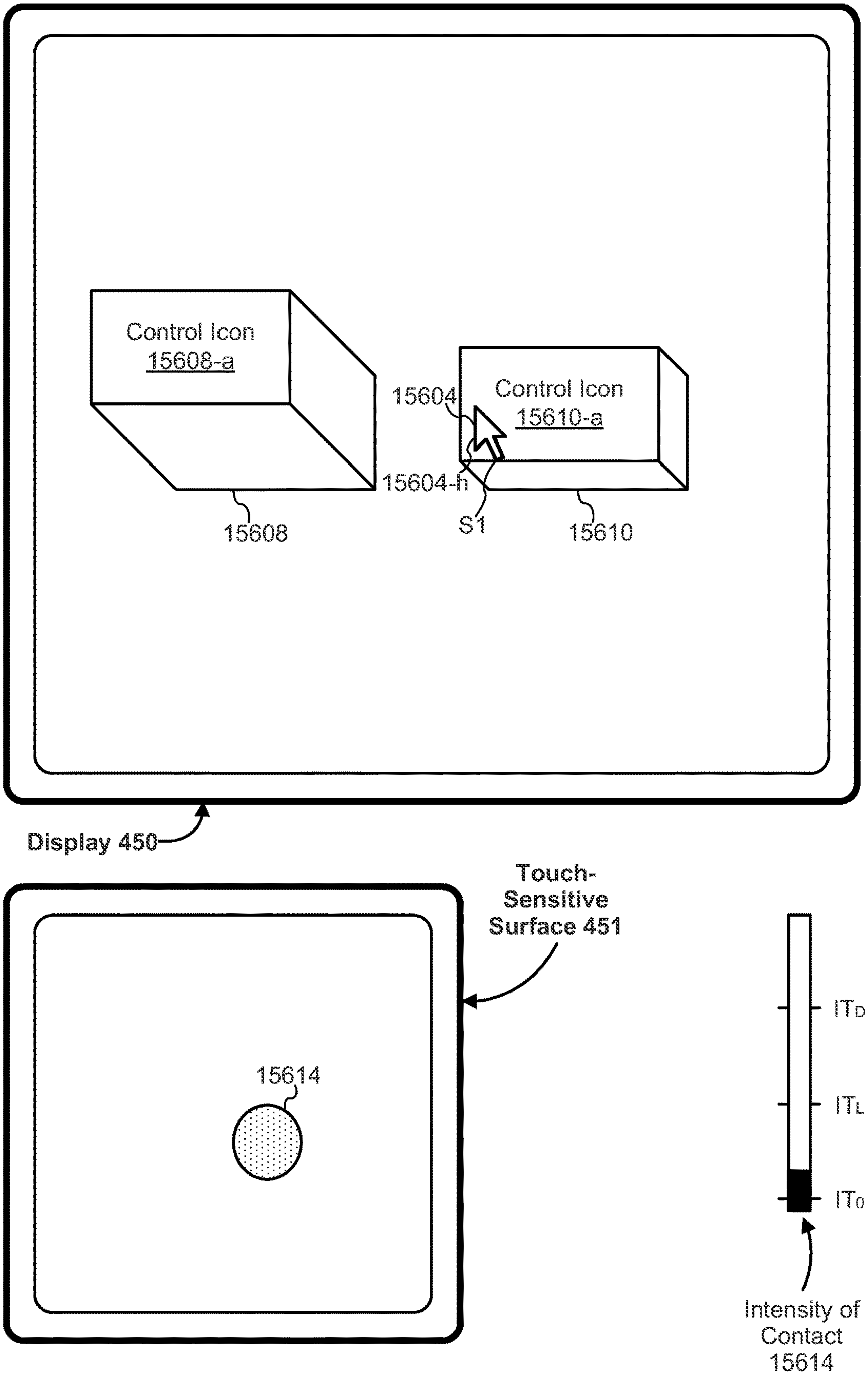

Control Icon
15608-a
Control Icon
15610-a
15604
15604-h
S1
15608
15610
Display 450
Touch-Sensitive Surface 451
15614
IT_D
IT_L
IT_0
Intensity of Contact 15614

Figure 8J

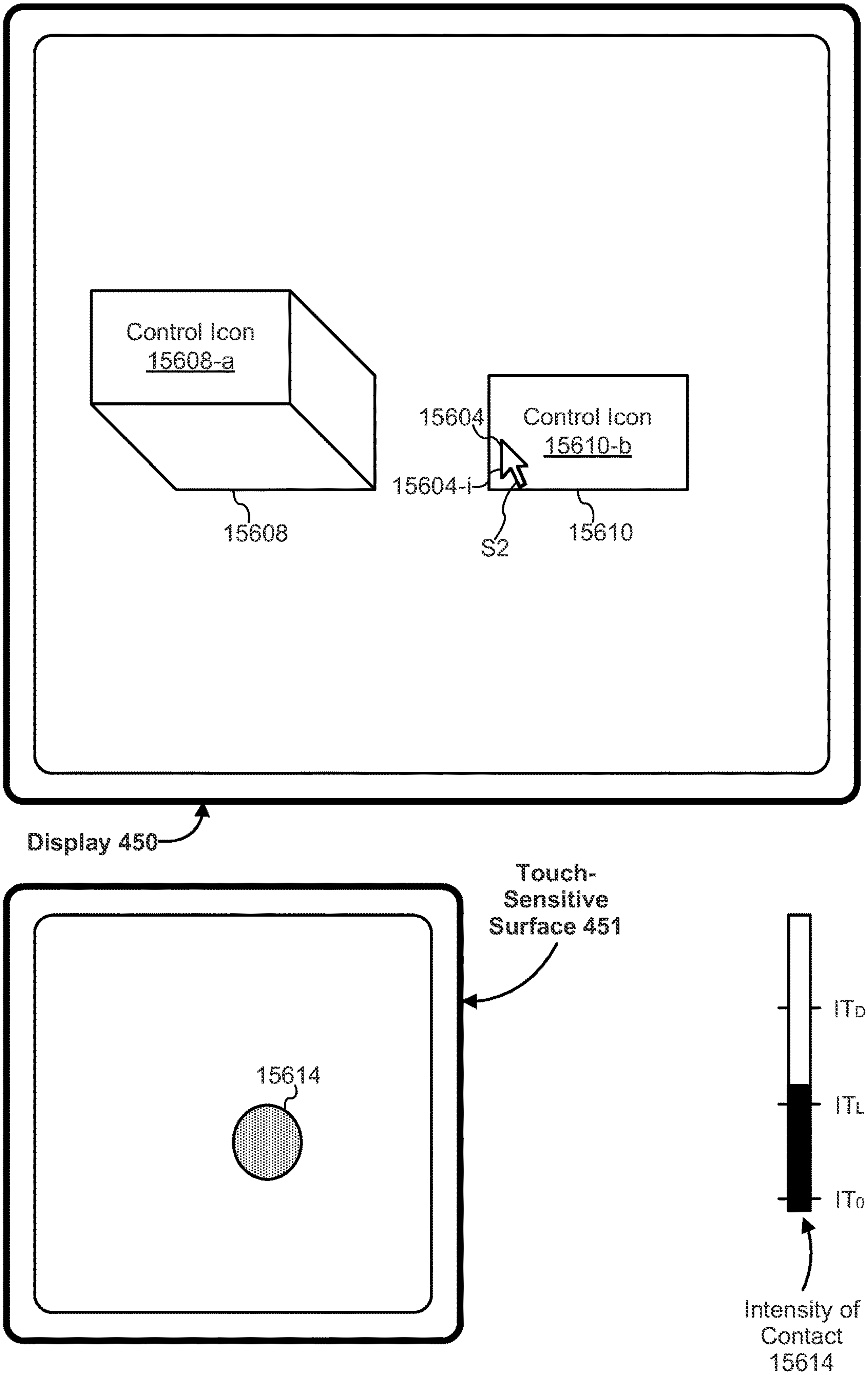

Control Icon
15608-a
Control Icon
15610-b
15604
15604-i
15608
S2
15610
Display 450
Touch-Sensitive Surface 451
15614
ITD
ITL
IT0
Intensity of Contact 15614

Figure 8K

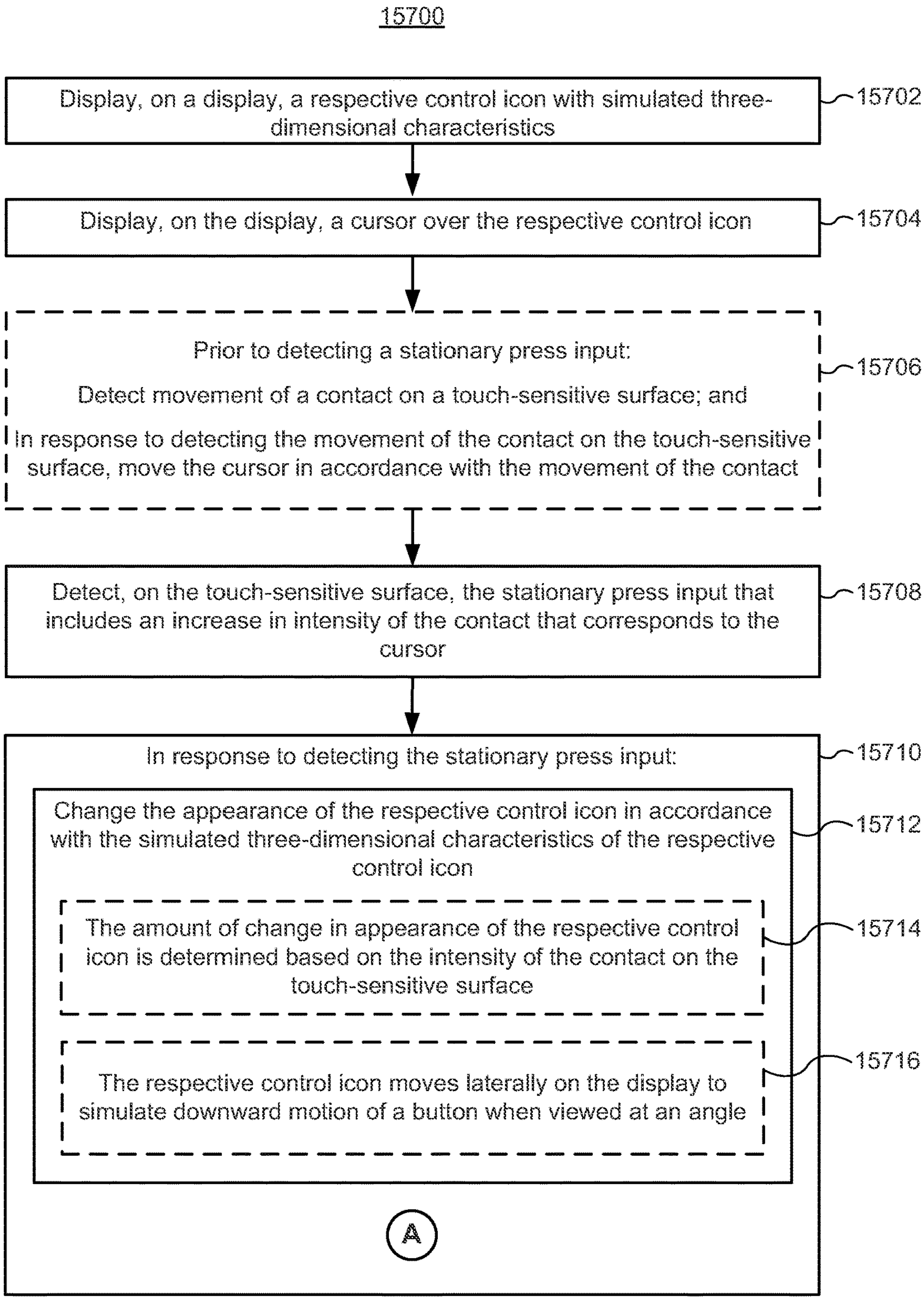

15700
Display, on a display, a respective control icon with simulated three-dimensional characteristics
15702
Display, on the display, a cursor over the respective control icon
15704
Prior to detecting a stationary press input:
Detect movement of a contact on a touch-sensitive surface; and
In response to detecting the movement of the contact on the touch-sensitive surface, move the cursor in accordance with the movement of the contact
15706
Detect, on the touch-sensitive surface, the stationary press input that includes an increase in intensity of the contact that corresponds to the cursor
15708
In response to detecting the stationary press input:
15710
Change the appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon
15712
The amount of change in appearance of the respective control icon is determined based on the intensity of the contact on the touch-sensitive surface
15714
The respective control icon moves laterally on the display to simulate downward motion of a button when viewed at an angle
15716
A

Figure 9A

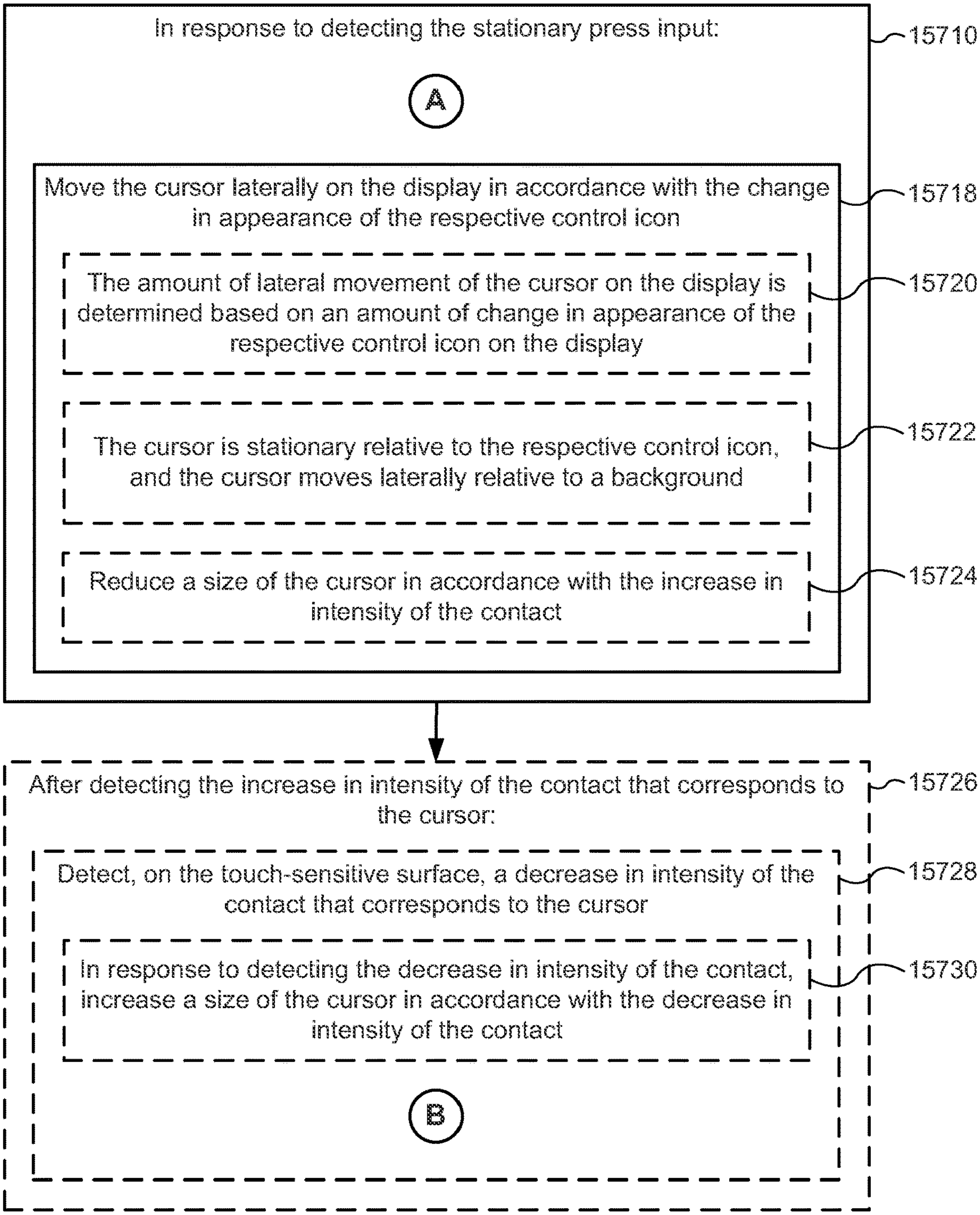

In response to detecting the stationary press input:
15710
A
Move the cursor laterally on the display in accordance with the change in appearance of the respective control icon
15718
The amount of lateral movement of the cursor on the display is determined based on an amount of change in appearance of the respective control icon on the display
15720
The cursor is stationary relative to the respective control icon, and the cursor moves laterally relative to a background
15722
Reduce a size of the cursor in accordance with the increase in intensity of the contact
15724
After detecting the increase in intensity of the contact that corresponds to the cursor:
15726
Detect, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor
15728
In response to detecting the decrease in intensity of the contact, increase a size of the cursor in accordance with the decrease in intensity of the contact
15730
B

Figure 9B

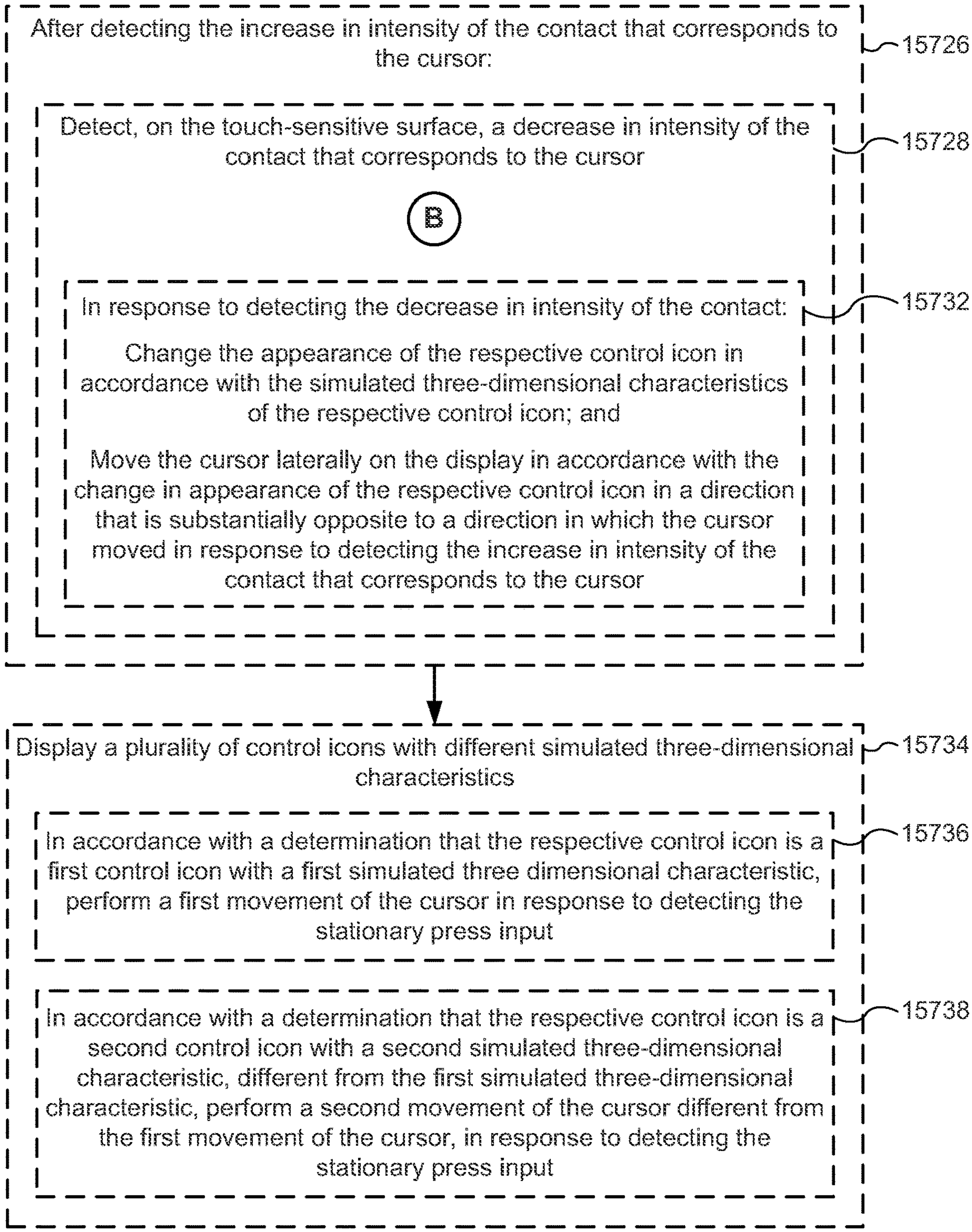

After detecting the increase in intensity of the contact that corresponds to the cursor:
15726
Detect, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor
15728
B
In response to detecting the decrease in intensity of the contact:
Change the appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon; and
Move the cursor laterally on the display in accordance with the change in appearance of the respective control icon in a direction that is substantially opposite to a direction in which the cursor moved in response to detecting the increase in intensity of the contact that corresponds to the cursor
15732
Display a plurality of control icons with different simulated three-dimensional characteristics
15734
In accordance with a determination that the respective control icon is a first control icon with a first simulated three dimensional characteristic, perform a first movement of the cursor in response to detecting the stationary press input
15736
In accordance with a determination that the respective control icon is a second control icon with a second simulated three-dimensional characteristic, different from the first simulated three-dimensional characteristic, perform a second movement of the cursor different from the first movement of the cursor, in response to detecting the stationary press input
15738

Figure 9C

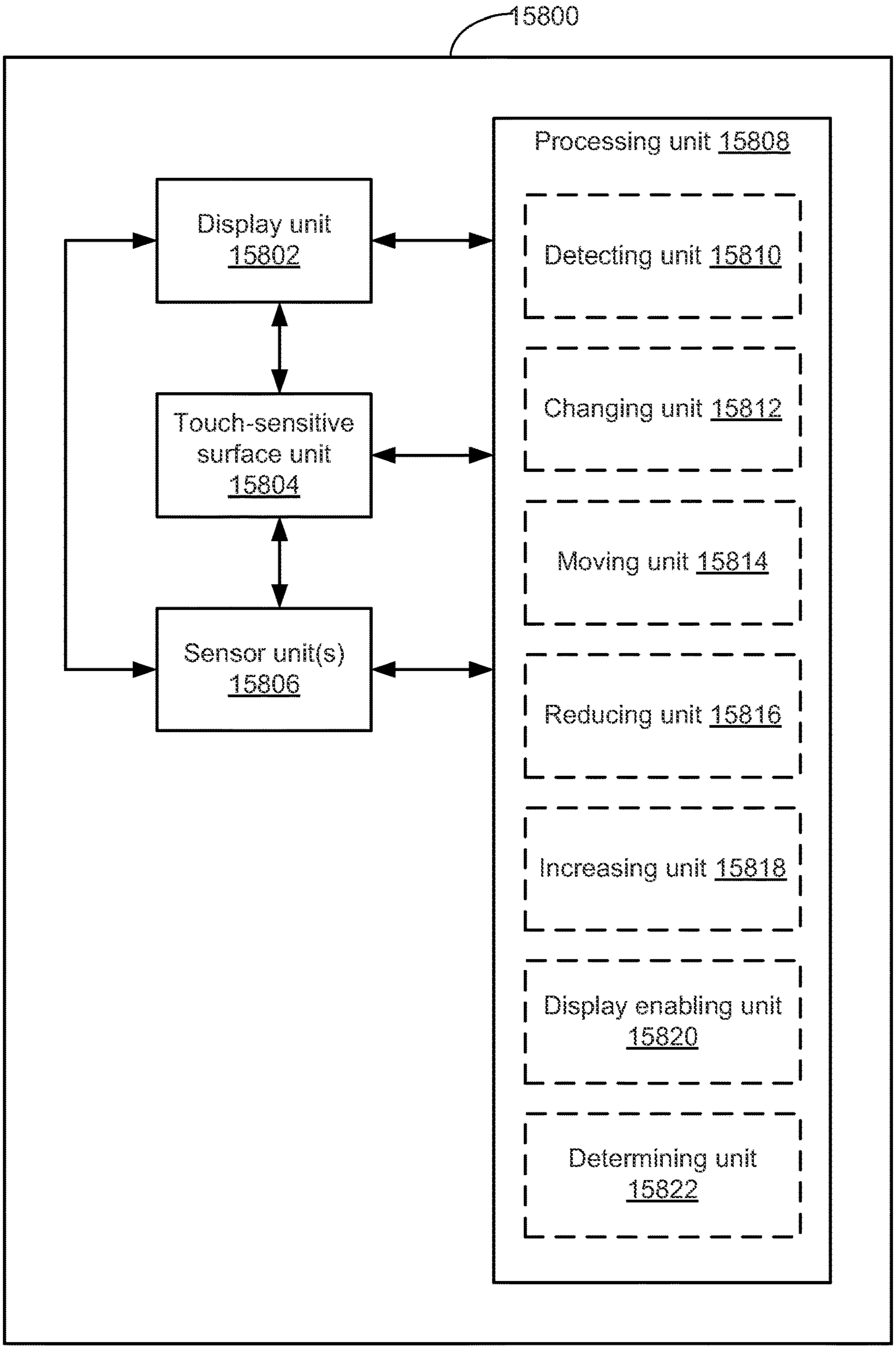

15800
Processing unit 15808
Display unit 15802
Detecting unit 15810
Changing unit 15812
Touch-sensitive surface unit 15804
Moving unit 15814
Sensor unit(s) 15806
Reducing unit 15816
Increasing unit 15818
Display enabling unit 15820
Determining unit 15822

Figure 10

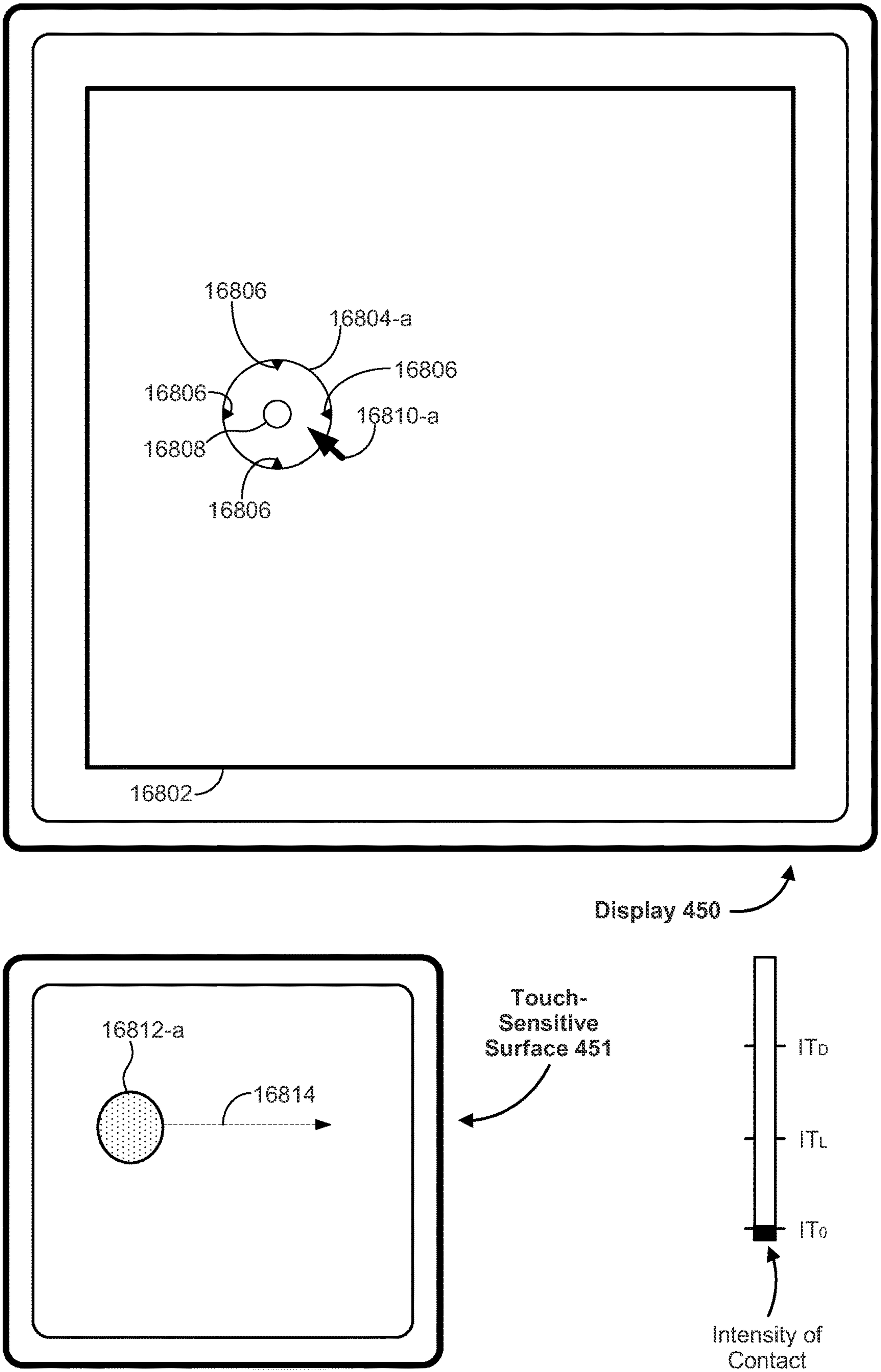

16806
16804-a
16806
16806
16810-a
16808
16806
16802
Display 450
16812-a
16814
Touch-Sensitive Surface 451
ITD
ITL
IT0
Intensity of Contact 16812

Figure 11A

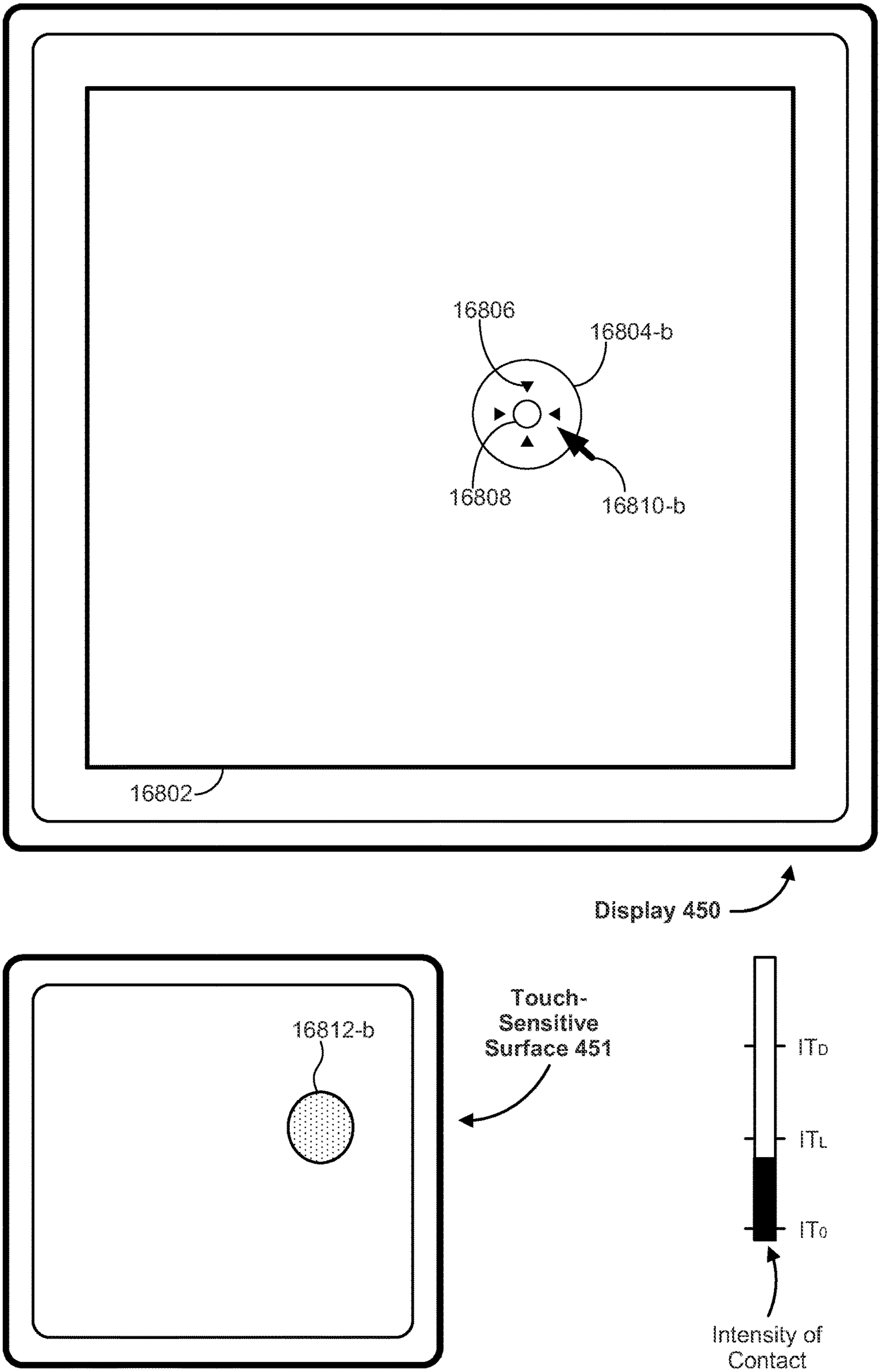

16806
16804-b
16808
16810-b
16802
Display 450
Touch-Sensitive Surface 451
16812-b
IT_D
IT_L
IT_0
Intensity of Contact 16812

Figure 11B

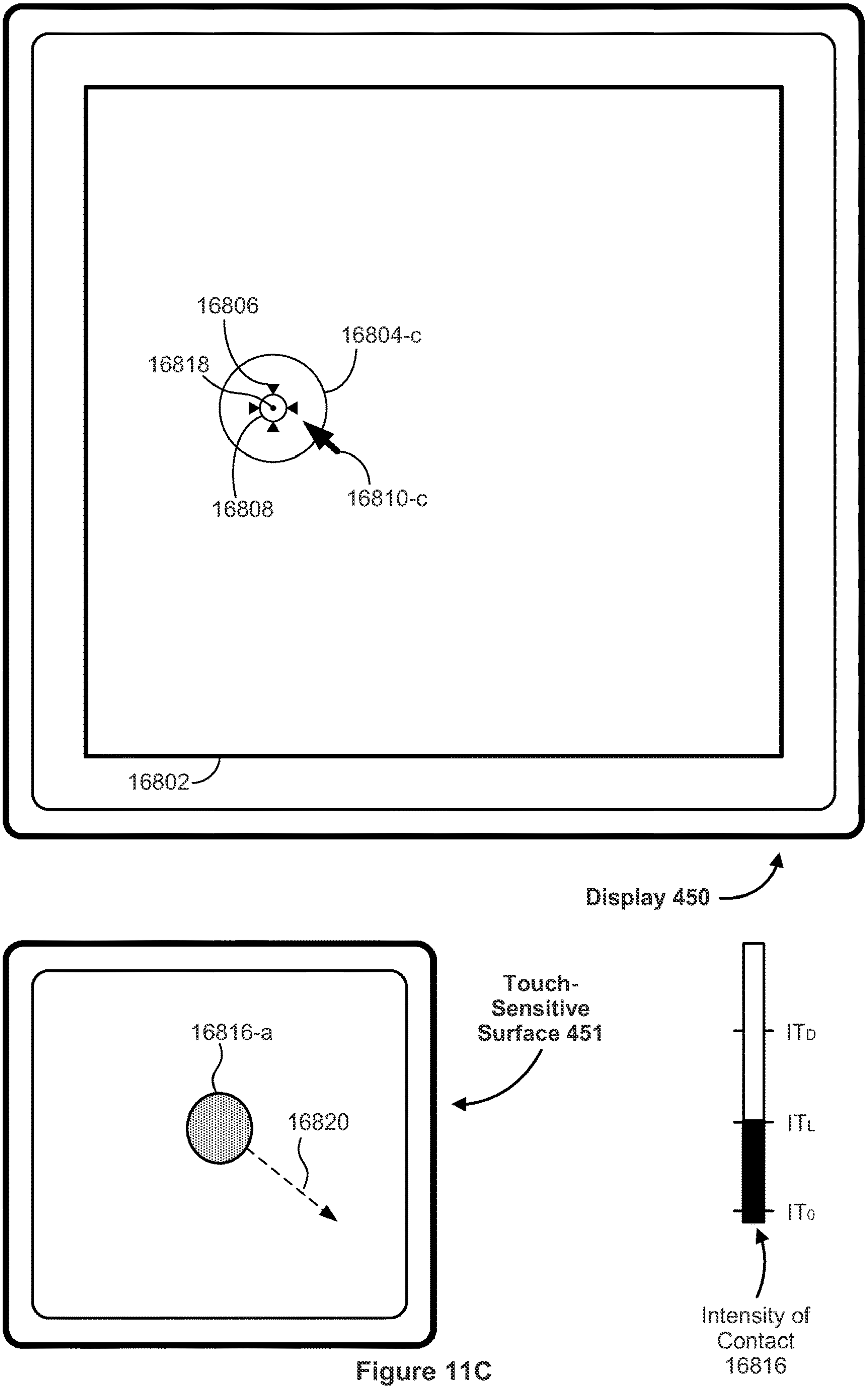

16806
16804-c
16818
16808
16810-c
16802
Display 450
Touch-Sensitive Surface 451
16816-a
16820
ITD
ITL
IT0
Intensity of Contact 16816

Figure 11C

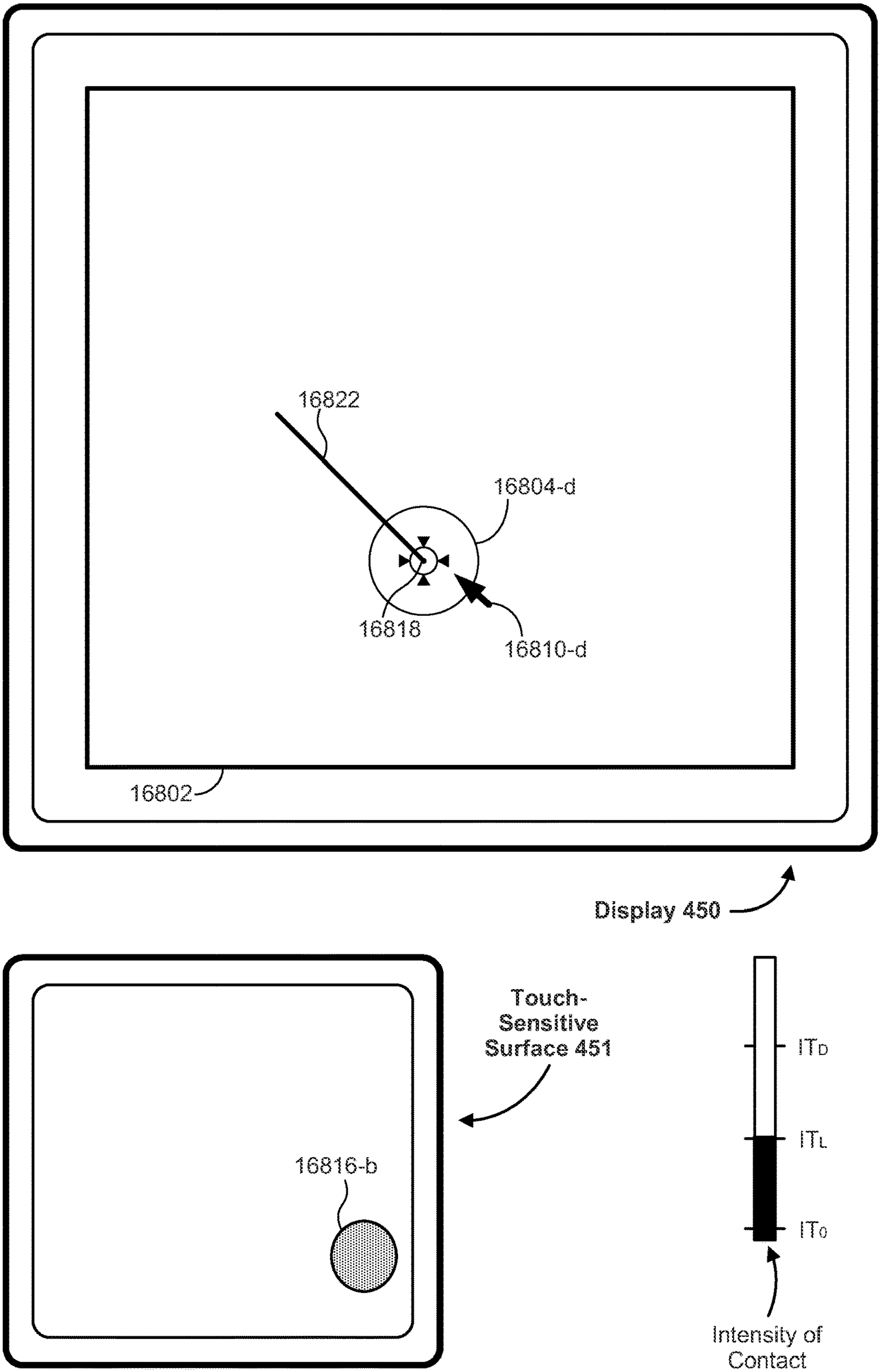

16822
16804-d
16818
16810-d
16802
Display 450
Touch-Sensitive Surface 451
16816-b
IT_D
IT_L
IT_0
Intensity of Contact 16816

Figure 11D

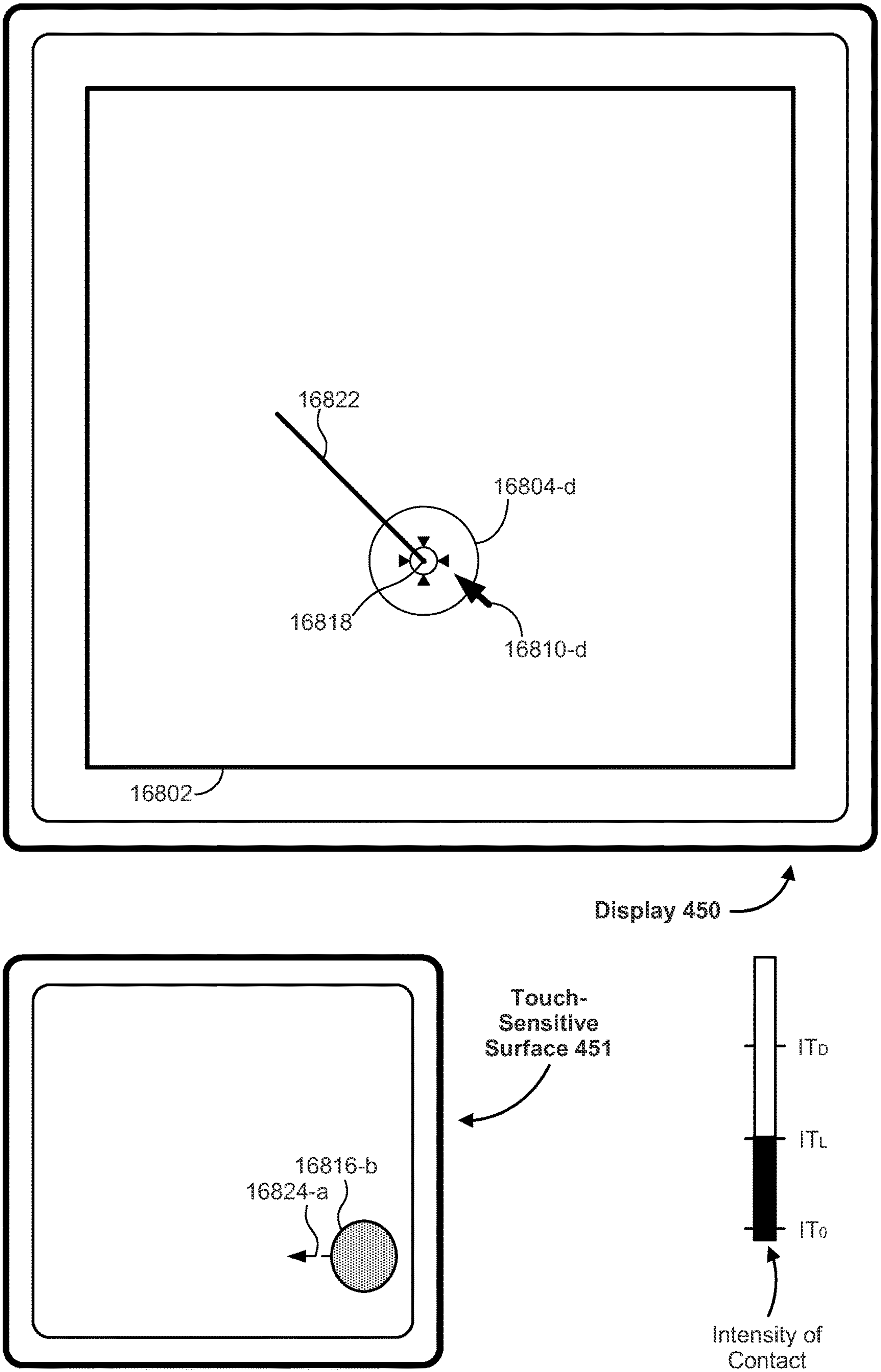

16822
16804-d
16818
16810-d
16802
Display 450
Touch-Sensitive Surface 451
16816-b
16824-a
ITD
ITL
IT0
Intensity of Contact 16816

Figure 11E

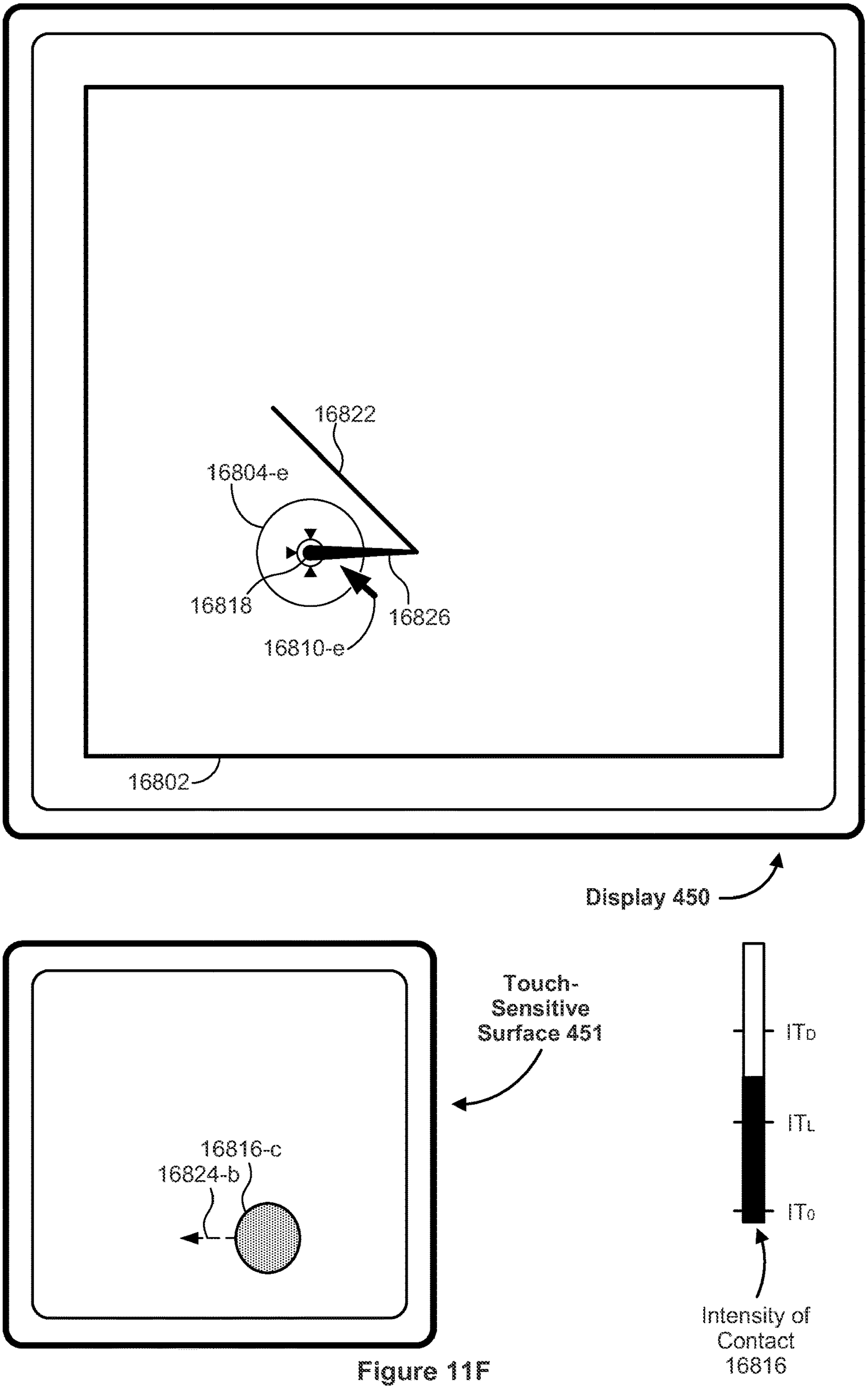
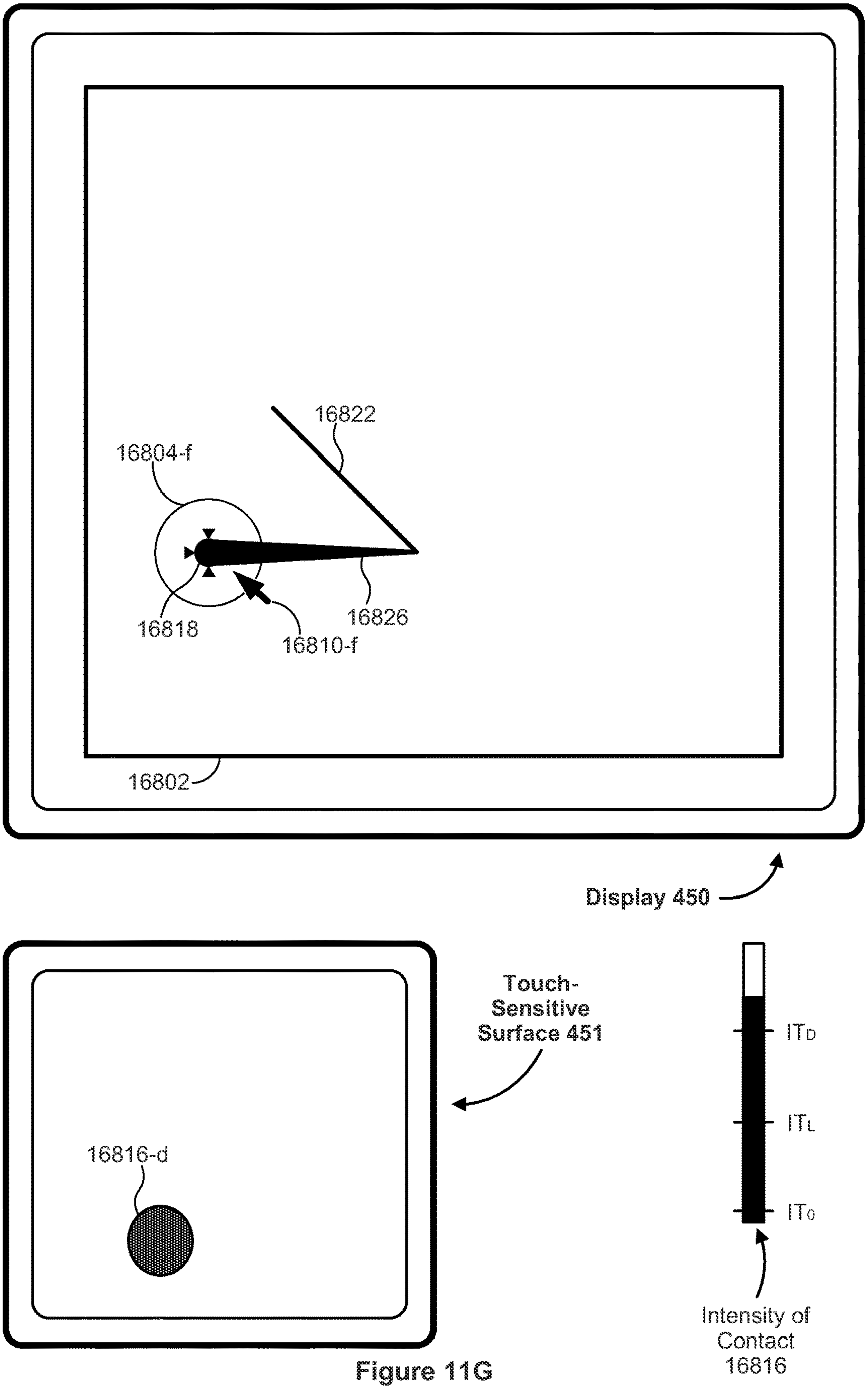

16822
16804-e
16818
16826
16810-e
16802
Display 450
Touch-Sensitive Surface 451
16816-c
16824-b
ITD
ITL
IT0
Intensity of Contact 16816

Figure 11F



16822
16804-f
16818
16810-f
16826
16802
Display 450
Touch-Sensitive Surface 451
16816-d
ITD
ITL
IT0
Intensity of Contact 16816

Figure 11G

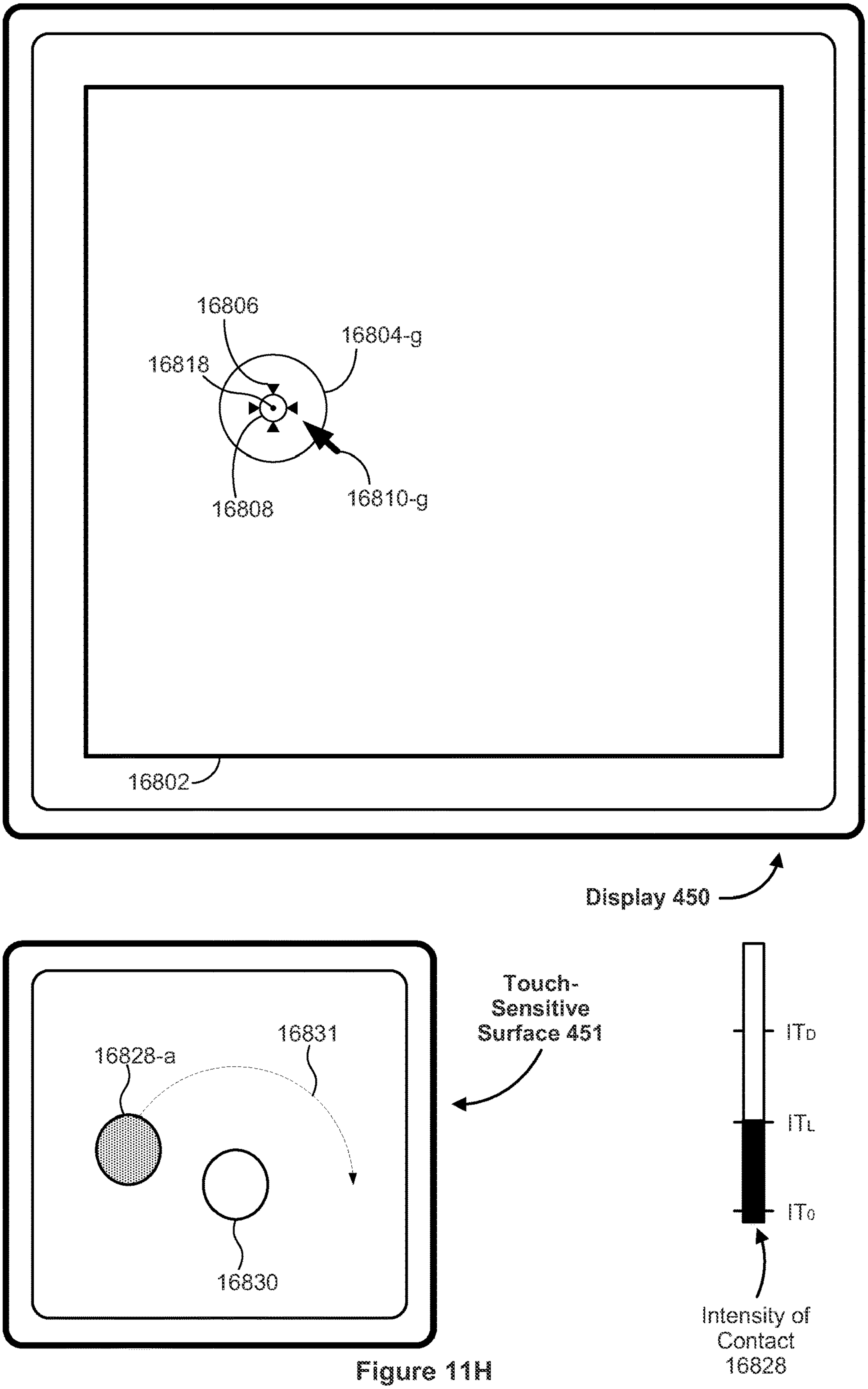

16806
16804-g
16818
16808
16810-g
16802
Display 450
Touch-Sensitive Surface 451
16831
16828-a
16830
IT_D
IT_L
IT_0
Intensity of Contact 16828

Figure 11H

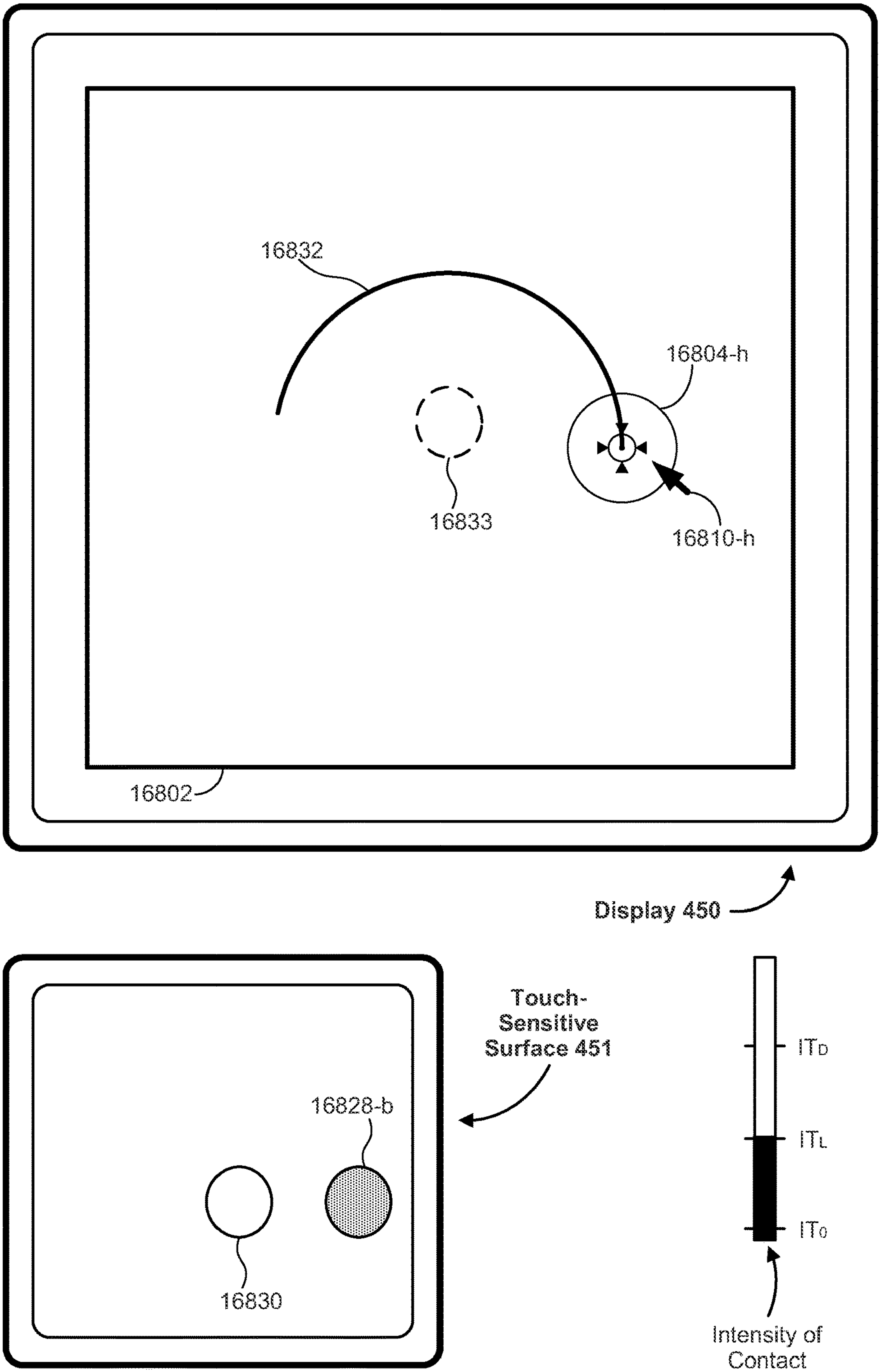

16832
16804-h
16833
16810-h
16802
Display 450
Touch-Sensitive Surface 451
16828-b
16830
IT_D
IT_L
IT_0
Intensity of Contact 16828

Figure 11I

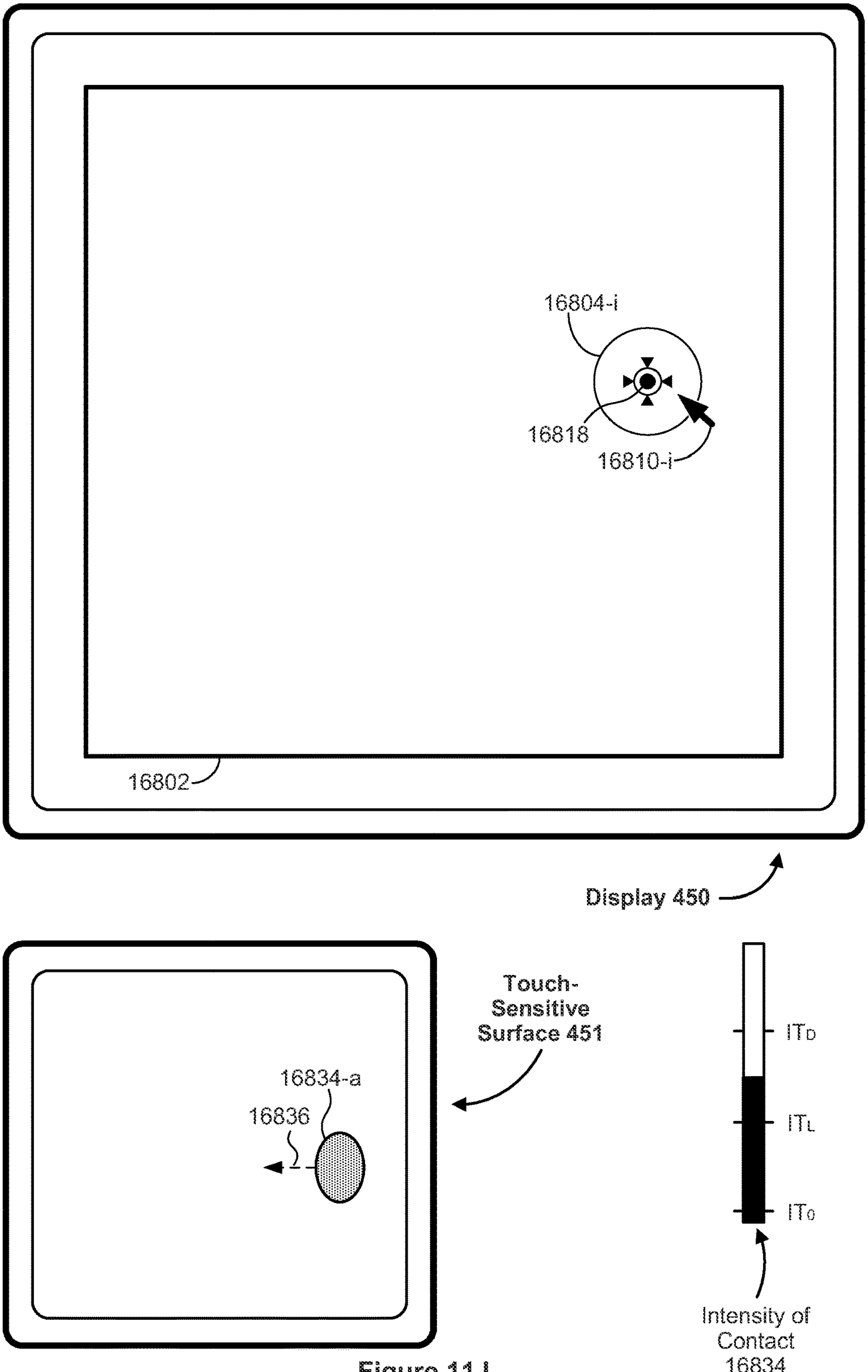

16804-i
16818
16810-i
16802
Display 450
Touch-Sensitive Surface 451
16834-a
16836
IT_D
IT_L
IT_0
Intensity of Contact 16834

Figure 11J

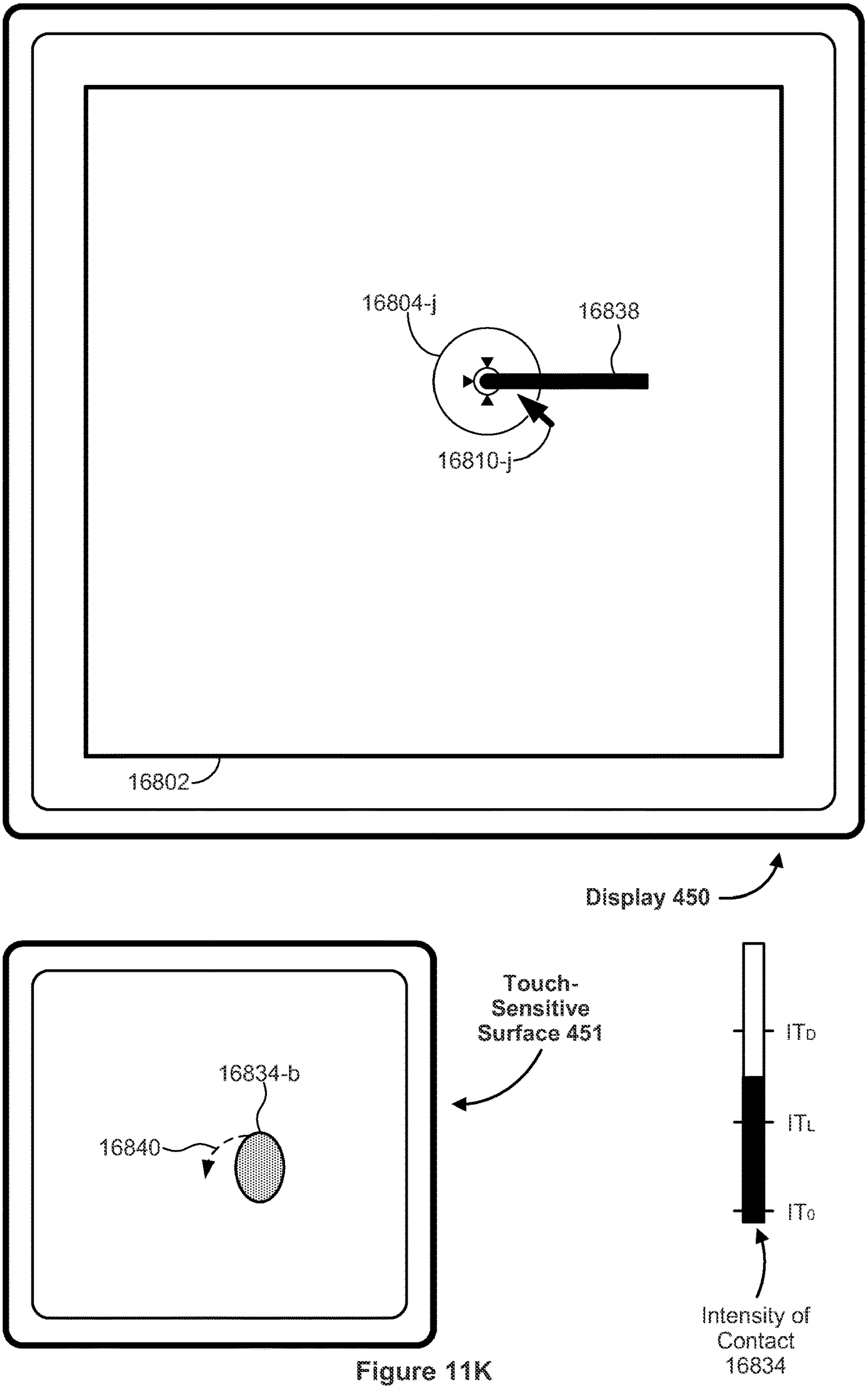

16804-j
16838
16810-j
16802
Display 450
Touch-Sensitive Surface 451
16834-b
16840
ITD
ITL
IT0
Intensity of Contact 16834

Figure 11K

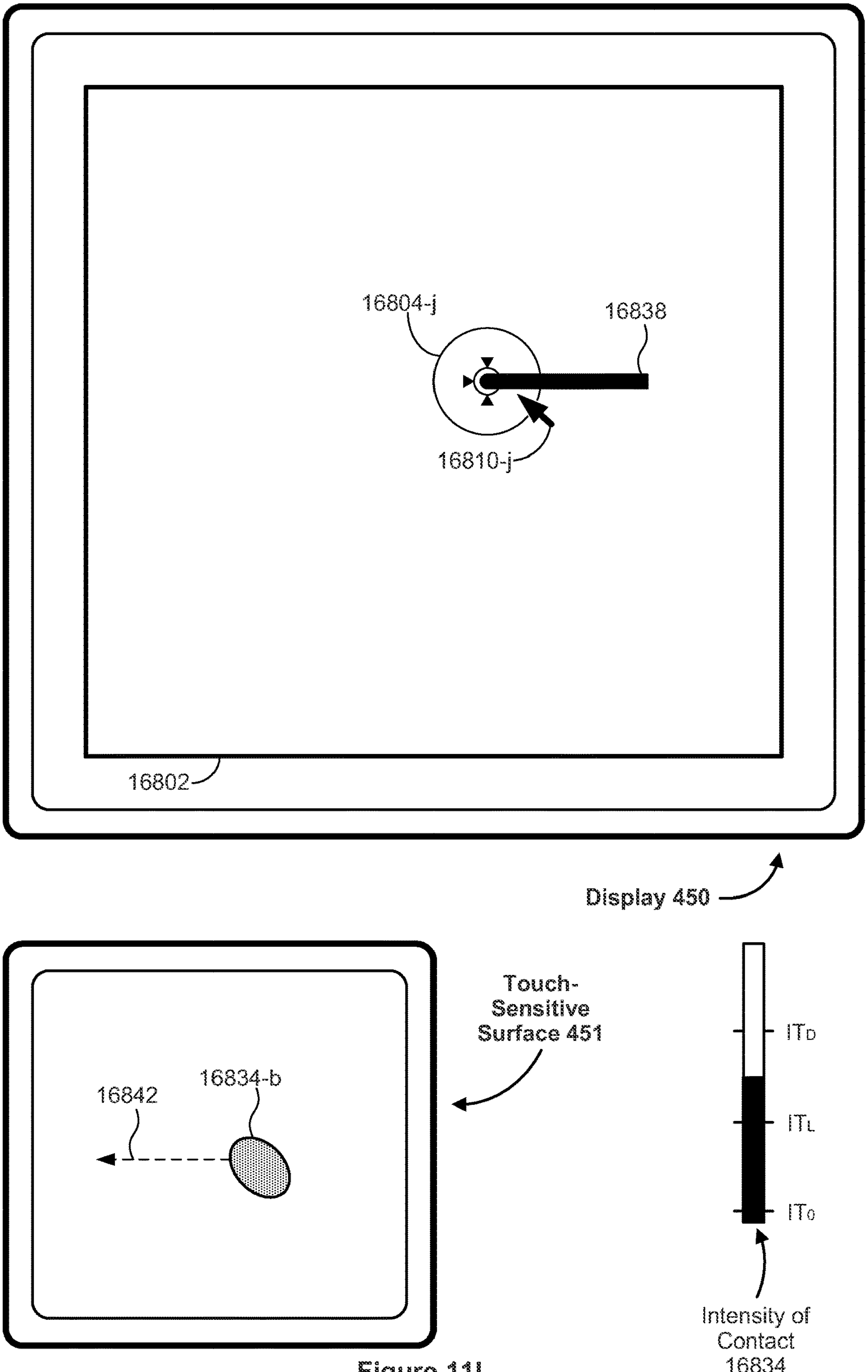

16804-j
16838
16810-j
16802
Display 450
Touch-Sensitive Surface 451
16842
16834-b
IT_D
IT_L
IT_0
Intensity of Contact 16834

Figure 11L

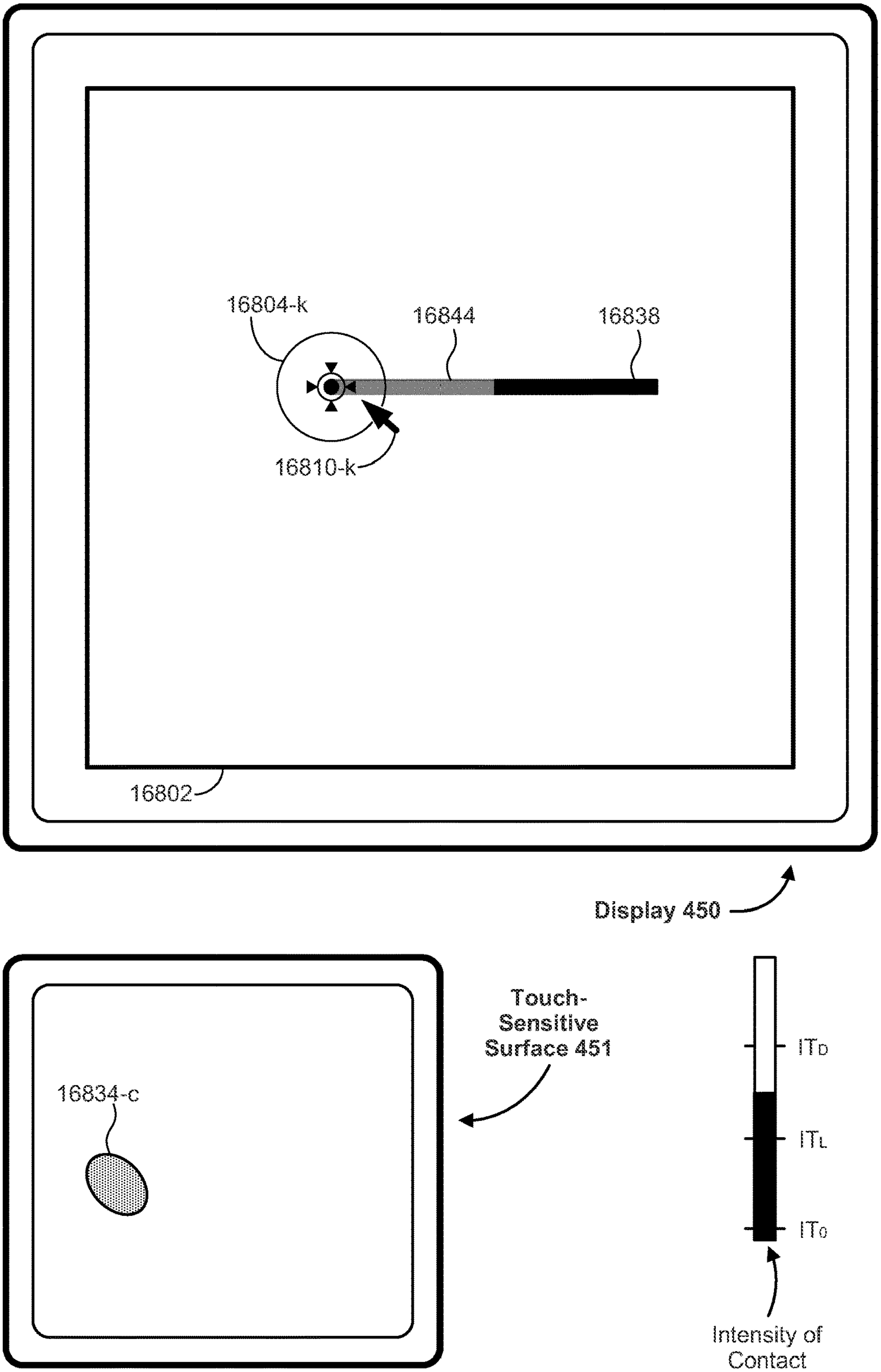

16804-k
16844
16838
16810-k
16802
Display 450
Touch-Sensitive Surface 451
16834-c
ITD
ITL
IT0
Intensity of Contact 16834

Figure 11M

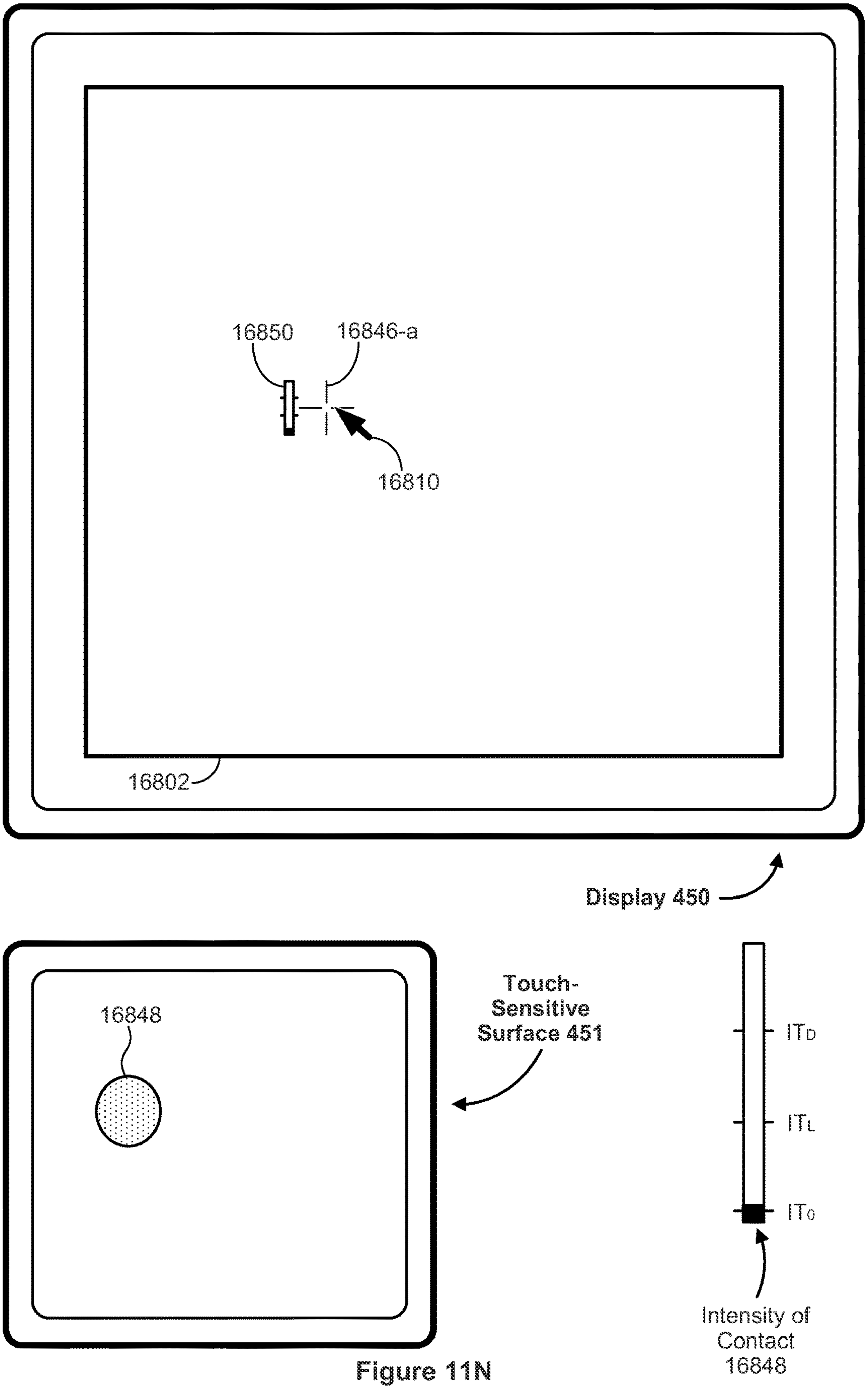

16850
16846-a
16810
16802
Display 450
16848
Touch-Sensitive Surface 451
IT_D
IT_L
IT_0
Intensity of Contact 16848

Figure 11N

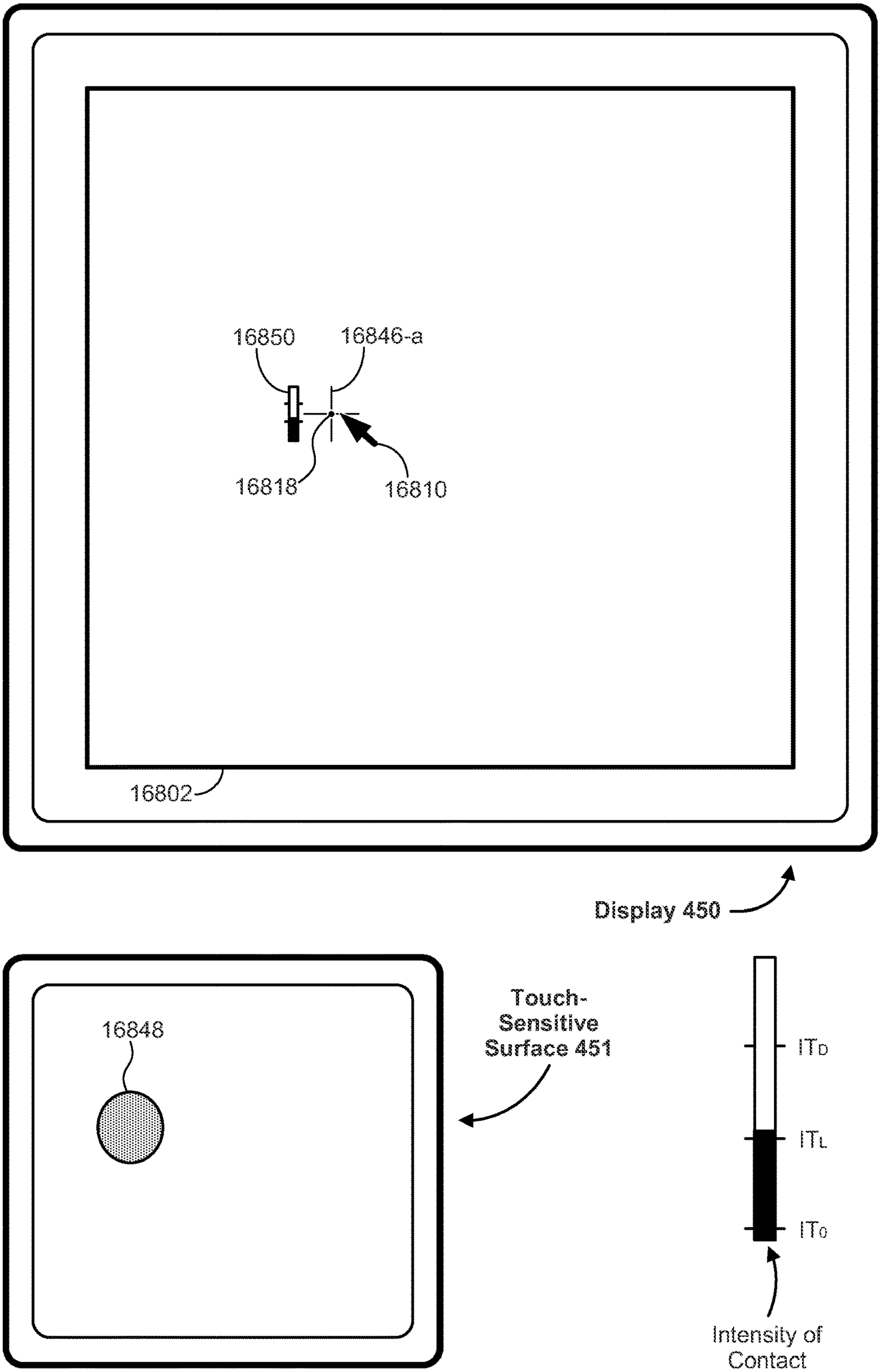

16850
16846-a
16818
16810
16802
Display 450
16848
Touch-Sensitive Surface 451
ITD
ITL
IT0
Intensity of Contact 16848

Figure 11O

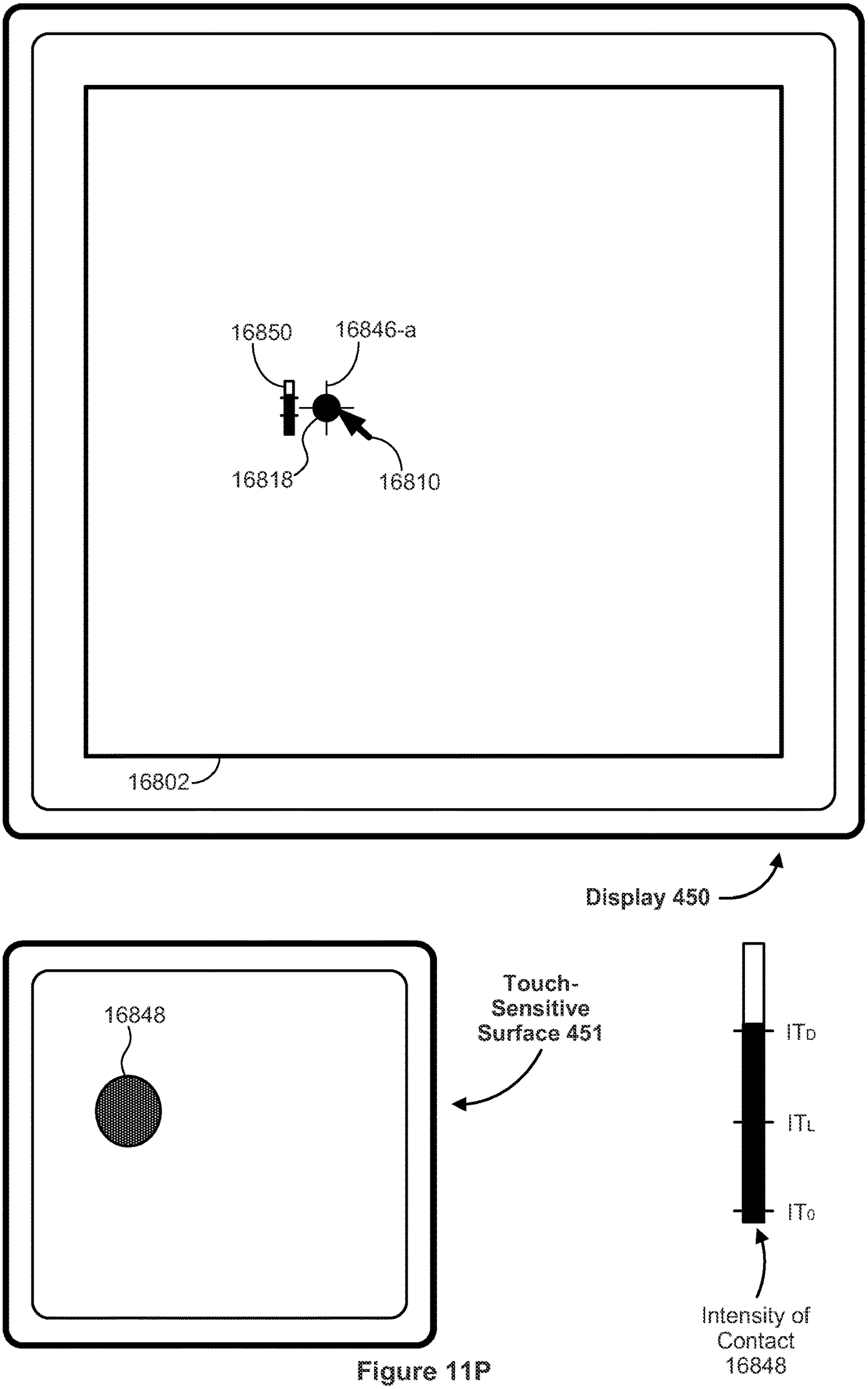

16850
16846-a
16818
16810
16802
Display 450
16848
Touch-Sensitive Surface 451
ITD
ITL
IT0
Intensity of Contact 16848

Figure 11P

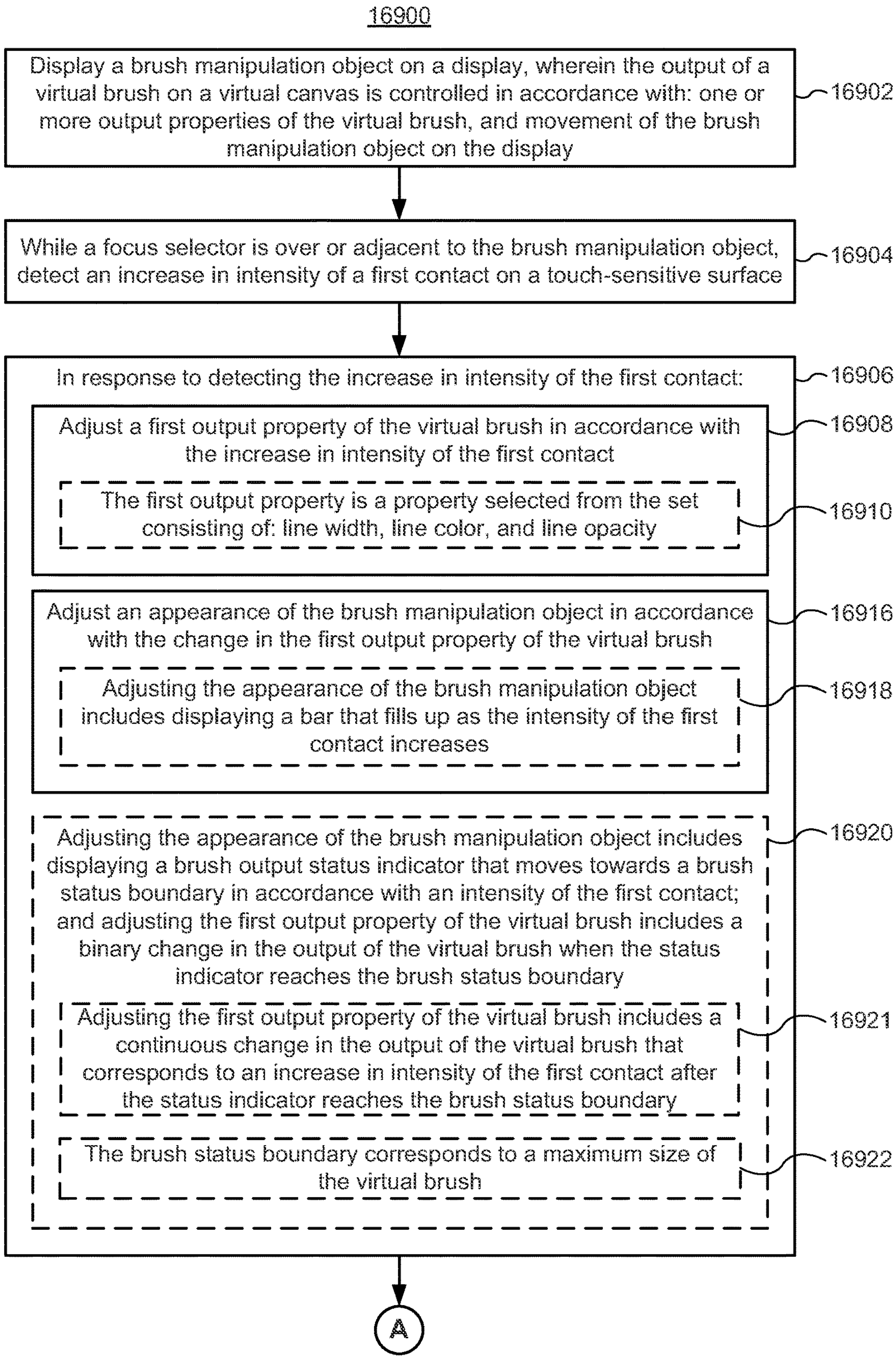

16900
Display a brush manipulation object on a display, wherein the output of a virtual brush on a virtual canvas is controlled in accordance with: one or more output properties of the virtual brush, and movement of the brush manipulation object on the display
16902
While a focus selector is over or adjacent to the brush manipulation object, detect an increase in intensity of a first contact on a touch-sensitive surface
16904
In response to detecting the increase in intensity of the first contact:
16906
Adjust a first output property of the virtual brush in accordance with the increase in intensity of the first contact
16908
The first output property is a property selected from the set consisting of: line width, line color, and line opacity
16910
Adjust an appearance of the brush manipulation object in accordance with the change in the first output property of the virtual brush
16916
Adjusting the appearance of the brush manipulation object includes displaying a bar that fills up as the intensity of the first contact increases
16918
Adjusting the appearance of the brush manipulation object includes displaying a brush output status indicator that moves towards a brush status boundary in accordance with an intensity of the first contact; and adjusting the first output property of the virtual brush includes a binary change in the output of the virtual brush when the status indicator reaches the brush status boundary
16920
Adjusting the first output property of the virtual brush includes a continuous change in the output of the virtual brush that corresponds to an increase in intensity of the first contact after the status indicator reaches the brush status boundary
16921
The brush status boundary corresponds to a maximum size of the virtual brush
16922
A

Figure 12A

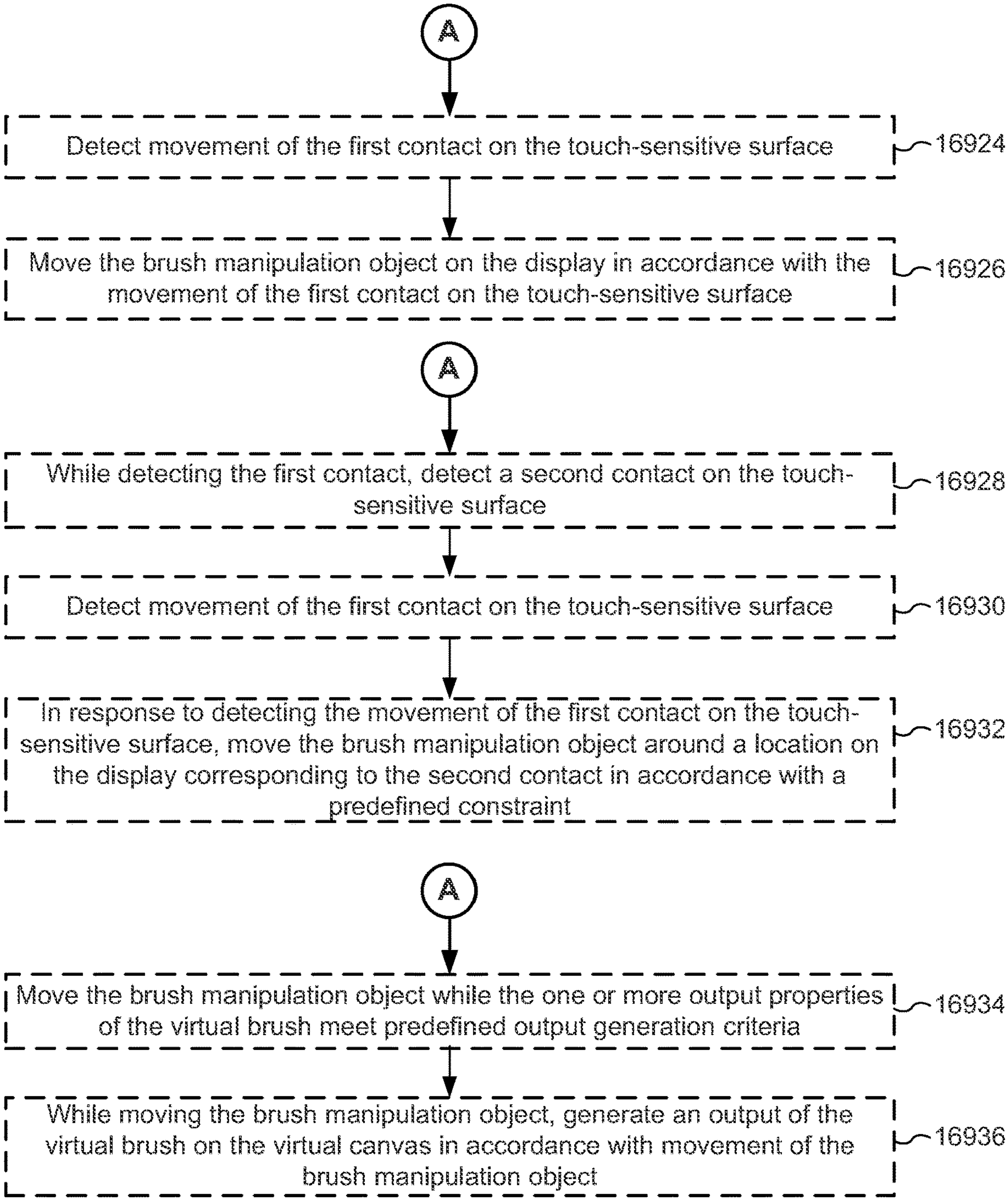

A
Detect movement of the first contact on the touch-sensitive surface
16924
Move the brush manipulation object on the display in accordance with the movement of the first contact on the touch-sensitive surface
16926
A
While detecting the first contact, detect a second contact on the touch-sensitive surface
16928
Detect movement of the first contact on the touch-sensitive surface
16930
In response to detecting the movement of the first contact on the touch-sensitive surface, move the brush manipulation object around a location on the display corresponding to the second contact in accordance with a predefined constraint
16932
A
Move the brush manipulation object while the one or more output properties of the virtual brush meet predefined output generation criteria
16934
While moving the brush manipulation object, generate an output of the virtual brush on the virtual canvas in accordance with movement of the brush manipulation object
16936

Figure 12B

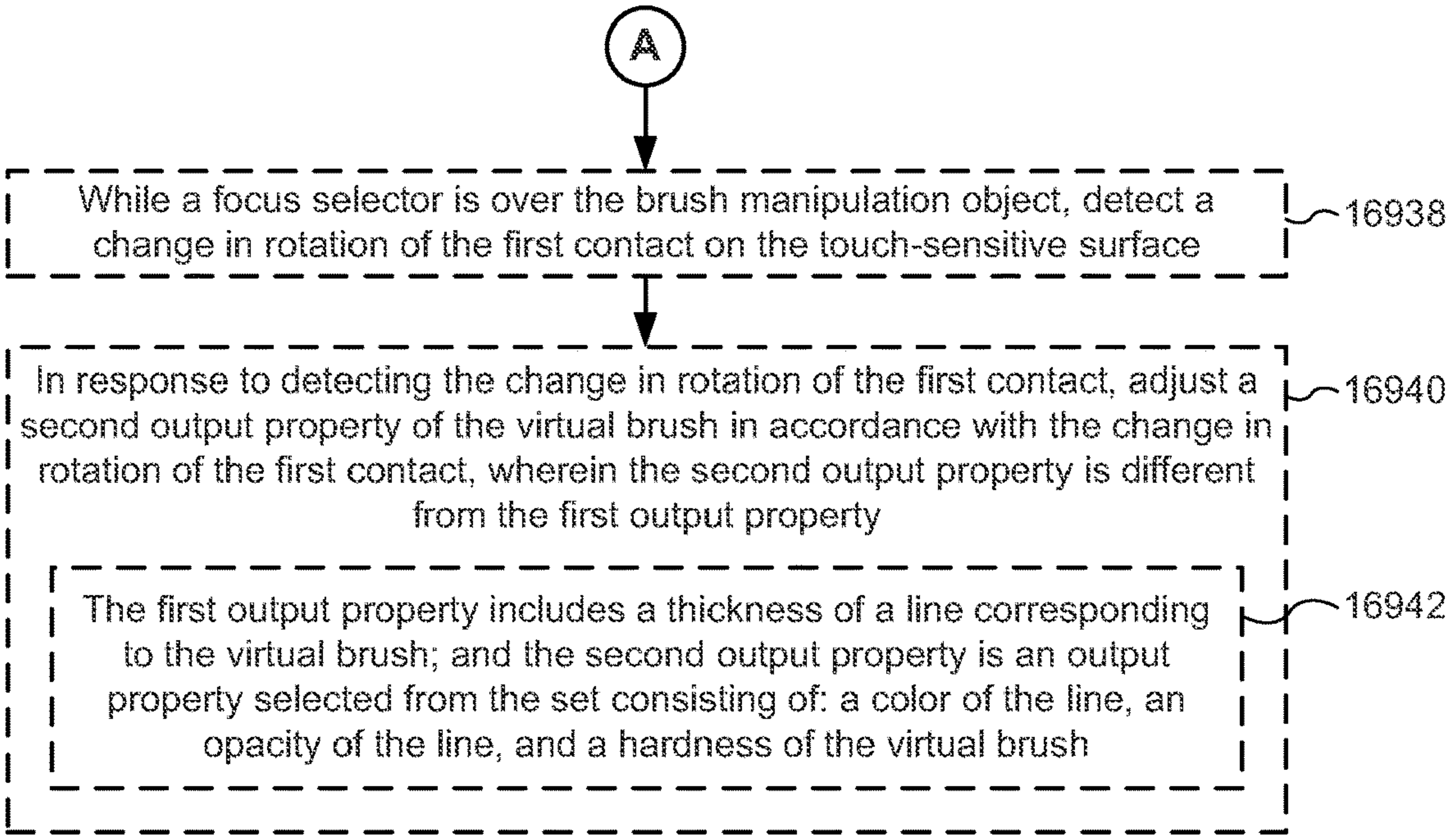

A
While a focus selector is over the brush manipulation object, detect a change in rotation of the first contact on the touch-sensitive surface
16938
In response to detecting the change in rotation of the first contact, adjust a second output property of the virtual brush in accordance with the change in rotation of the first contact, wherein the second output property is different from the first output property
16940
The first output property includes a thickness of a line corresponding to the virtual brush; and the second output property is an output property selected from the set consisting of: a color of the line, an opacity of the line, and a hardness of the virtual brush
16942

Figure 12C

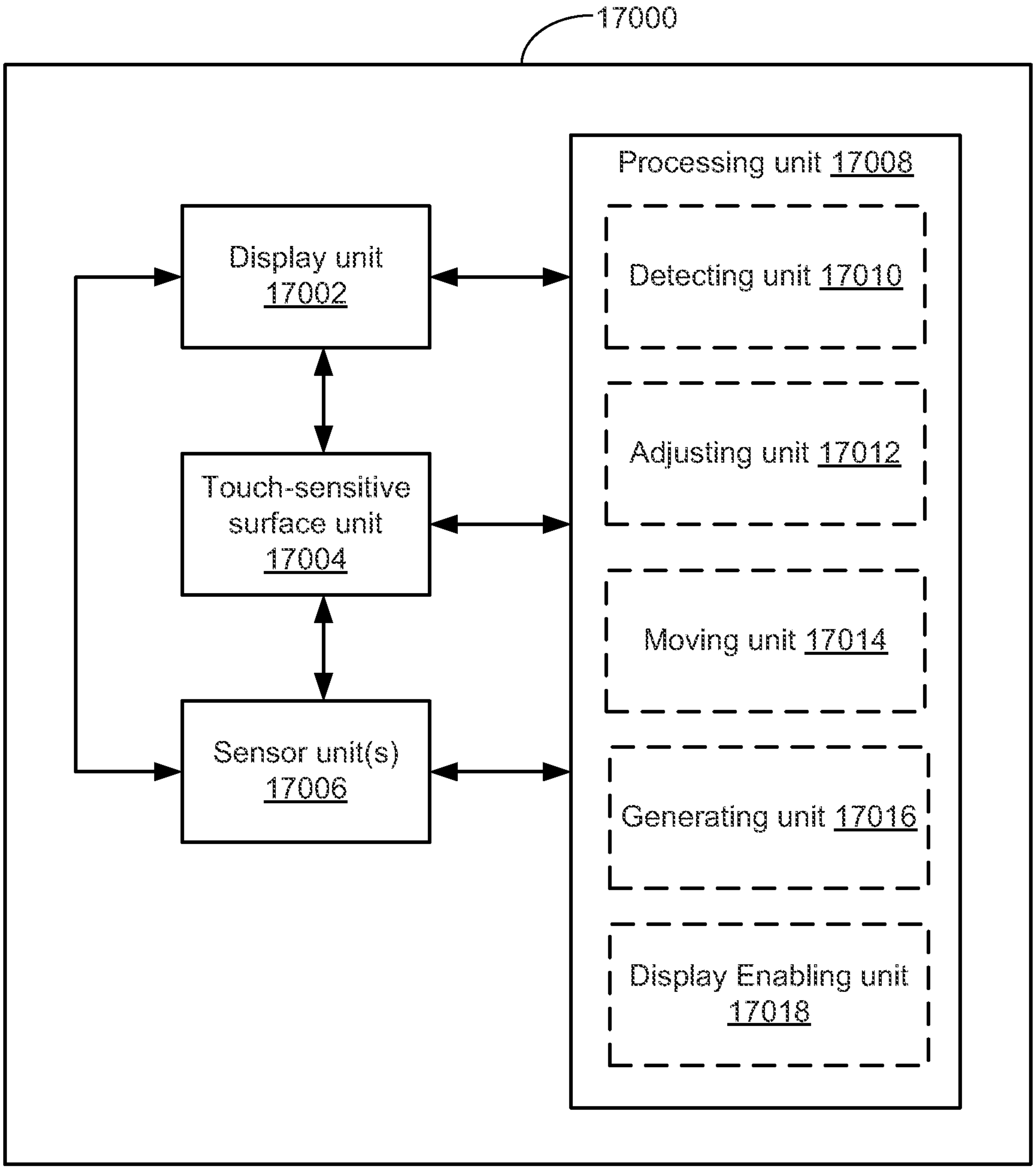

17000
Processing unit 17008
Display unit 17002
Detecting unit 17010
Adjusting unit 17012
Touch-sensitive surface unit 17004
Moving unit 17014
Sensor unit(s) 17006
Generating unit 17016
Display Enabling unit 17018

Figure 13

DEVICE, METHOD, AND GRAPHICAL USER INTERFACE FOR MOVING A CURSOR ACCORDING TO A CHANGE IN AN APPEARANCE OF A CONTROL ICON WITH SIMULATED THREE-DIMENSIONAL CHARACTERISTICS

RELATED APPLICATIONS

This application is a continuation of PCT Patent Application Serial No. PCT/US2013/069484, filed on Nov. 11, 2013, entitled "Device, Method, and Graphical User Interface for Moving a Cursor According to a Change in an Appearance of a Control Icon with Simulated Three-Dimensional Characteristics," which claims the benefit of and priority to U.S. Provisional Patent Application Ser. No. 61/778,373, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Managing Activation of a Control Based on Contact Intensity;" and U.S. Provisional Patent Application No. 61/747,278, filed Dec. 29, 2012, entitled "Device, Method, and Graphical User Interface for Manipulating User Interface Objects with Visual and/or Haptic Feedback," which applications are incorporated by reference herein in their entireties.

This application is also related to the following: U.S. Provisional Patent Application Ser. No. 61/778,092, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Selecting Object within a Group of Objects;" U.S. Provisional Patent Application Ser. No. 61/778,125, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Navigating User Interface Hierarchies;" U.S. Provisional Patent Application Ser. No. 61/778,156, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Manipulating Framed Graphical Objects;" U.S. Provisional Patent Application Ser. No. 61/778,179, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Scrolling Nested Regions;" U.S. Provisional Patent Application Ser. No. 61/778,171, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Displaying Additional Information in Response to a User Contact;" U.S. Provisional Patent Application Ser. No. 61/778,191, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Displaying User Interface Objects Corresponding to an Application;" U.S. Provisional Patent Application Ser. No. 61/778,211, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Facilitating User Interaction with Controls in a User Interface;" U.S. Provisional Patent Application Ser. No. 61/778,239, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Forgoing Generation of Tactile Output for a Multi-Contact Gesture;" U.S. Provisional Patent Application Ser. No. 61/778,284, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Providing Tactile Feedback for Operations Performed in a User Interface;" U.S. Provisional Patent Application Ser. No. 61/778,287, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Providing Feedback for Changing Activation States of a User Interface Object;" U.S. Provisional Patent Application Ser. No. 61/778,363, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Transitioning between Touch Input to Display Output Relationships;" U.S. Provisional Patent Application Ser. No. 61/778,367, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Moving a User Interface Object Based on an Intensity of a Press Input;" U.S. Provisional Patent Application Ser. No. 61/778,265, filed on Mar. 12, 2013, entitled "Device, Method, and Graphical User Interface for Transitioning between Display States in Response to a Gesture;" U.S. Provisional Patent Application Ser. No. 61/778,412, filed on Mar. 13, 2013, entitled "Device, Method, and Graphical User Interface for Displaying Content Associated with a Corresponding Affordance;" U.S. Provisional Patent Application Ser. No. 61/778,413, filed on Mar. 13, 2013, entitled "Device, Method, and Graphical User Interface for Selecting User Interface Objects;" U.S. Provisional Patent Application Ser. No. 61/778,414, filed on Mar. 13, 2013, entitled "Device, Method, and Graphical User Interface for Moving and Dropping a User Interface Object;" U.S. Provisional Patent Application Ser. No. 61/778,416, filed on Mar. 13, 2013, entitled "Device, Method, and Graphical User Interface for Determining Whether to Scroll or Select Content;" and U.S. Provisional Patent Application Ser. No. 61/778,418, filed on Mar. 13, 2013, entitled "Device, Method, and Graphical User Interface for Switching between User Interfaces," which are incorporated herein by reference in their entireties.

This application is also related to the following: U.S. Provisional Patent Application Ser. No. 61/645,033, filed on May 9, 2012, entitled "Adaptive Haptic Feedback for Electronic Devices;" U.S. Provisional Patent Application Ser. No. 61/665,603, filed on Jun. 28, 2012, entitled "Adaptive Haptic Feedback for Electronic Devices;" and U.S. Provisional Patent Application Ser. No. 61/681,098, filed on Aug. 8, 2012, entitled "Adaptive Haptic Feedback for Electronic Devices," which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

This relates generally to electronic devices with touch-sensitive surfaces, including but not limited to electronic devices with touch-sensitive surfaces that detect inputs for manipulating user interfaces.

BACKGROUND

The use of touch-sensitive surfaces as input devices for computers and other electronic computing devices has increased significantly in recent years. Exemplary touch-sensitive surfaces include touch pads and touch screen displays. Such surfaces are widely used to manipulate user interface objects on a display.

Exemplary manipulations include adjusting the position and/or size of one or more user interface objects or activating buttons or opening files/applications represented by user interface objects, as well as associating metadata with one or more user interface objects or otherwise manipulating user interfaces. Exemplary user interface objects include digital images, video, text, icons, control elements such as buttons and other graphics. A user will, in some circumstances, need to perform such manipulations on user interface objects in a file management program (e.g., Finder from Apple Inc. of Cupertino, Calif.), an image management application (e.g., Aperture or iPhoto from Apple Inc. of Cupertino, Calif.), a digital content (e.g., videos and music) management application (e.g., iTunes from Apple Inc. of Cupertino, Calif.), a drawing application, a presentation application (e.g., Keynote from Apple Inc. of Cupertino, Calif.), a word processing application (e.g., Pages from Apple Inc. of Cupertino, Calif.), a website creation application (e.g., iWeb from Apple Inc. of Cupertino, Calif.), a disk authoring application (e.g., iDVD from Apple Inc. of Cupertino, Calif.), or a spreadsheet application (e.g., Numbers from Apple Inc. of Cupertino, Calif.).

But existing methods for performing these manipulations are cumbersome and inefficient. In addition, existing methods take longer than necessary, thereby wasting energy. This latter consideration is particularly important in battery-operated devices.

SUMMARY

Accordingly, there is a need for electronic devices with faster, more efficient methods and interfaces for manipulating user interfaces. Such methods and interfaces optionally complement or replace conventional methods for manipulating user interfaces. Such methods and interfaces reduce the cognitive burden on a user and produce a more efficient human-machine interface. For battery-operated devices, such methods and interfaces conserve power and increase the time between battery charges.

The above deficiencies and other problems associated with user interfaces for electronic devices with touch-sensitive surfaces are reduced or eliminated by the disclosed devices. In some embodiments, the device is a desktop computer. In some embodiments, the device is portable (e.g., a notebook computer, tablet computer, or handheld device). In some embodiments, the device has a touchpad. In some embodiments, the device has a touch-sensitive display (also known as a "touch screen" or "touch screen display"). In some embodiments, the device has a graphical user interface (GUI), one or more processors, memory and one or more modules, programs or sets of instructions stored in the memory for performing multiple functions. In some embodiments, the user interacts with the GUI primarily through finger contacts and gestures on the touch-sensitive surface. In some embodiments, the functions optionally include image editing, drawing, presenting, word processing, website creating, disk authoring, spreadsheet making, game playing, telephoning, video conferencing, e-mailing, instant messaging, workout support, digital photographing, digital videoing, web browsing, digital music playing, and/or digital video playing. Executable instructions for performing these functions are, optionally, included in a non-transitory computer readable storage medium or other computer program product configured for execution by one or more processors.

There is a need for electronic devices with faster, more efficient methods and interfaces for managing activation of controls that provide users with an indication of progress toward activating a respective control. Such methods and interfaces may complement or replace conventional methods for managing activation of controls. Such methods and interfaces reduce the cognitive burden on a user and produce a more efficient human-machine interface. For battery-operated devices, such methods and interfaces conserve power and increase the time between battery charges.

In accordance with some embodiments, a method is performed at an electronic device with a display, a touch-sensitive surface and one or more sensors to detect intensity of contacts with the touch-sensitive surface. The method includes: displaying, on the display, a respective control associated with respective contact intensity criteria. The method further includes while a focus selector is at a location on the display that corresponds to the respective control: detecting a gesture, on the touch-sensitive surface, that corresponds to an interaction with the respective control; and while detecting the gesture, in accordance with a determination that the gesture does not include a contact that meets the respective contact intensity criteria, changing the appearance of the respective control to indicate progress toward meeting the respective contact intensity criteria.

In accordance with some embodiments, an electronic device includes a display unit configured to display on the display unit, a respective control associated with respective contact intensity criteria; a touch-sensitive surface unit configured to receive a contact on the touch-sensitive surface unit; one or more sensor units configured to detect intensity of contacts with the touch-sensitive surface unit; and a processing unit coupled to the display unit, the sensor units and the touch-sensitive surface unit. The processing unit is configured to: while a focus selector is at a location on the display unit that corresponds to the respective control: detect a gesture, on the touch-sensitive surface unit, that corresponds to an interaction with the respective control; and while detecting the gesture, in accordance with a determination that the gesture does not include a contact that meets the respective contact intensity criteria, change the appearance of the respective control to indicate progress toward meeting the respective contact intensity criteria.

Thus, electronic devices with displays, touch-sensitive surfaces and one or more sensors to detect intensity of contacts with the touch-sensitive surface are provided with faster, more efficient methods and interfaces for managing activation of controls based on the intensity (e.g., pressure) and/or duration of a contact, thereby increasing the effectiveness, efficiency, and user satisfaction with such devices. Such methods and interfaces may complement or replace conventional methods for managing activation of controls.

There is a need for electronic devices with faster, more efficient methods and interfaces for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics. Such methods and interfaces may complement or replace conventional methods for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics. Such methods and interfaces reduce the cognitive burden on a user and produce a more efficient human-machine interface. For battery-operated devices, such methods and interfaces conserve power and increase the time between battery charges.

In accordance with some embodiments, a method is performed at an electronic device with a display, a touch-sensitive surface and one or more sensors to detect intensity of contacts with the touch-sensitive surface. The method includes: displaying a respective control icon with simulated three-dimensional characteristics and a cursor over the respective control icon; and detecting, on the touch-sensitive surface, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor. In response to detecting the stationary press input, the method further includes: changing an appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon; and moving the cursor laterally on the display in accordance with the change in appearance of the respective control icon.

In accordance with some embodiments, an electronic device includes: a display unit configured to display a respective control icon with simulated three-dimensional characteristics and a cursor over the respective control icon; a touch-sensitive surface unit configured to receive contacts; one or more sensor units configured to detect intensity of contacts with the touch-sensitive surface unit; and a processing unit coupled to the display unit, the touch-sensitive surface unit and the one or more sensor units. The processing unit is configured to: detect, on the touch-sensitive surface unit, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor. In response to detecting the stationary press input, the processing unit is further configured to: change an appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon; and move the cursor laterally on the display unit in accordance with the change in appearance of the respective control icon.

Thus, electronic devices with displays, touch-sensitive surfaces and one or more sensors to detect intensity of contacts with the touch-sensitive surface are provided with faster, more efficient methods and interfaces for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics, thereby increasing the effectiveness, efficiency, and user satisfaction with such devices. Such methods and interfaces may complement or replace conventional methods for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics.

There is a need for electronic devices with faster, more efficient methods and interfaces for adjusting properties of a virtual brush. Such methods and interfaces may complement or replace conventional methods for adjusting properties of a virtual brush. Such methods and interfaces reduce the cognitive burden on a user and produce a more efficient human-machine interface. For battery-operated devices, such methods and interfaces conserve power and increase the time between battery charges.

In accordance with some embodiments, a method is performed at an electronic device with a display, a touch-sensitive surface, and one or more sensors to detect intensity of contacts with the touch-sensitive surface. The method includes: displaying a brush manipulation object on the display, where the output of a virtual brush on a virtual canvas is controlled in accordance with: one or more output properties of the virtual brush and movement of the brush manipulation object on the display. The method further includes, while a focus selector is over or adjacent to the brush manipulation object, detecting an increase in intensity of a first contact on the touch-sensitive surface; and in response to detecting the increase in intensity of the first contact: adjusting a first output property of the virtual brush in accordance with the increase in intensity of the first contact, and adjusting an appearance of the brush manipulation object in accordance with the change in the first output property of the virtual brush.

In accordance with some embodiments, an electronic device includes a display unit configured to display a brush manipulation object on the display unit, where the output of a virtual brush on a virtual canvas is controlled in accordance with one or more output properties of the virtual brush and movement of the brush manipulation object on the display unit; a touch-sensitive surface unit configured to receive contacts; one or more sensors configured to detect intensity of contacts with the touch-sensitive surface unit; and a processing unit coupled to the display unit, the touch-sensitive surface unit and the one or more sensors. The processing unit is configured to: while a focus selector is over or adjacent to the brush manipulation object, detect an increase in intensity of a first contact on the touch-sensitive surface unit; and in response to detecting the increase in intensity of the first contact: adjust a first output property of the virtual brush in accordance with the increase in intensity of the first contact, and adjust an appearance of the brush manipulation object in accordance with the change in the first output property of the virtual brush.

Thus, electronic devices with displays, touch-sensitive surfaces, and one or more sensors to detect intensity of contacts with the touch-sensitive surface are provided with faster, more efficient methods and interfaces for adjusting properties of a virtual brush, thereby increasing the effectiveness, efficiency, and user satisfaction with such devices. Such methods and interfaces may complement or replace conventional methods for adjusting properties of a virtual brush.

In accordance with some embodiments, an electronic device includes a display, a touch-sensitive surface, optionally one or more sensors to detect intensity of contacts with the touch-sensitive surface, one or more processors, memory, and one or more programs; the one or more programs are stored in the memory and configured to be executed by the one or more processors and the one or more programs include instructions for performing the operations of any of the methods referred to in the fifth paragraph of the Description of Embodiments. In accordance with some embodiments, a graphical user interface on an electronic device with a display, a touch-sensitive surface, optionally one or more sensors to detect intensity of contacts with the touch-sensitive surface, a memory, and one or more processors to execute one or more programs stored in the memory includes one or more of the elements displayed in any of the methods referred to in the fifth paragraph of the Description of Embodiments, which are updated in response to inputs, as described in any of the methods referred to in the fifth paragraph of the Description of Embodiments. In accordance with some embodiments, a computer readable storage medium has stored therein instructions which when executed by an electronic device with a display, a touch-sensitive surface, and optionally one or more sensors to detect intensity of contacts with the touch-sensitive surface, cause the device to perform the operations of any of the methods referred to in the fifth paragraph of the Description of Embodiments. In accordance with some embodiments, an electronic device includes: a display, a touch-sensitive surface, and optionally one or more sensors to detect intensity of contacts with the touch-sensitive surface; and means for performing the operations of any of the methods referred to in the fifth paragraph of the Description of Embodiments. In accordance with some embodiments, an information processing apparatus, for use in an electronic device with a display and a touch-sensitive surface, optionally one or more sensors to detect intensity of contacts with the touch-sensitive surface, includes means for performing the operations of any of the methods referred to in the fifth paragraph of the Description of Embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the various described embodiments, reference should be made to the Description of Embodiments below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

FIG. **1**A is a block diagram illustrating a portable multifunction device with a touch-sensitive display in accordance with some embodiments.

FIG. **1**B is a block diagram illustrating exemplary components for event handling in accordance with some embodiments.

FIG. **2** illustrates a portable multifunction device having a touch screen in accordance with some embodiments.

FIG. **3** is a block diagram of an exemplary multifunction device with a display and a touch-sensitive surface in accordance with some embodiments.

FIG. **4**A illustrates an exemplary user interface for a menu of applications on a portable multifunction device in accordance with some embodiments.

FIG. **4**B illustrates an exemplary user interface for a multifunction device with a touch-sensitive surface that is separate from the display in accordance with some embodiments.

FIGS. **5**A-**5**M illustrate exemplary user interfaces for managing activation of controls based on the intensity and/or duration of a contact in accordance with some embodiments.

FIGS. **6**A-**6**D are flow diagrams illustrating a method of managing activation of controls based on the intensity and/or duration of a contact in accordance with some embodiments.

FIG. **7** is a functional block diagram of an electronic device in accordance with some embodiments.

FIGS. **8**A-**8**K illustrate exemplary user interfaces for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics in accordance with some embodiments.

FIGS. **9**A-**9**C are flow diagrams illustrating a method of moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics in accordance with some embodiments.

FIG. **10** is a functional block diagram of an electronic device in accordance with some embodiments.

FIGS. **11**A-**11**P illustrate exemplary user interfaces for adjusting properties of a virtual brush in accordance with some embodiments.

FIGS. **12**A-**12**C are flow diagrams illustrating a method of adjusting properties of a virtual brush in accordance with some embodiments.

FIG. **13** is a functional block diagram of an electronic device in accordance with some embodiments.

DESCRIPTION OF EMBODIMENTS

The methods, devices and GUIs described herein provide visual and/or haptic feedback that makes manipulation of user interface objects more efficient and intuitive for a user. For example, in a system where the clicking action of a trackpad is decoupled from the contact intensity (e.g., contact force, contact pressure, or a substitute therefore) that is needed to reach an activation threshold, the device can generate different tactile outputs (e.g., "different clicks") for different activation events (e.g., so that clicks that accomplish a particular result are differentiated from clicks that do not produce any result or that accomplish a different result from the particular result). Additionally, tactile outputs can be generated in response to other events that are not related to increasing intensity of a contact, such as generating a tactile output (e.g., a "detent") when a user interface object is moved to a particular position, boundary or orientation, or when an event occurs at the device.

Additionally, in a system where a trackpad or touchscreen display is sensitive to a range of contact intensity that includes more than one or two specific intensity values (e.g., more than a simple on/off, binary intensity determination), the user interface can provide responses (e.g., visual or tactile cues) that are indicative of the intensity of the contact within the range. In some implementations, a pre-activation-threshold response and/or a post-activation-threshold response to an input are displayed as continuous animations. As one example of such a response, a preview of an operation is displayed in response to detecting an increase in contact intensity that is still below an activation threshold for performing the operation. As another example of such a response, an animation associated with an operation continues even after the activation threshold for the operation has been reached. Both of these examples provide a user with a continuous response to the force or pressure of a user's contact, which provides a user with visual and/or haptic feedback that is richer and more intuitive. More specifically, such continuous force responses give the user the experience of being able to press lightly to preview an operation and/or press deeply to push "past" or "through" a predefined user interface state corresponding to the operation.

Additionally, for a device with a touch-sensitive surface that is sensitive to a range of contact intensity, multiple contact intensity thresholds can be monitored by the device and different functions can be mapped to different contact intensity thresholds. This serves to increase the available "gesture space" providing easy access to advanced features for users who know that increasing the intensity of a contact at or beyond a second "deep press" intensity threshold will cause the device to perform a different operation from an operation that would be performed if the intensity of the contact is between a first "activation" intensity threshold and the second "deep press" intensity threshold. An advantage of assigning additional functionality to a second "deep press" intensity threshold while maintaining familiar functionality at a first "activation" intensity threshold is that inexperienced users who are, in some circumstances, confused by the additional functionality can use the familiar functionality by just applying an intensity up to the first "activation" intensity threshold, whereas more experienced users can take advantage of the additional functionality by applying an intensity at the second "deep press" intensity threshold.

Additionally, for a device with a touch-sensitive surface that is sensitive to a range of contact intensity, the device can provide additional functionality by allowing users to perform complex operations with a single continuous contact. For example, when selecting a group of objects, a user can move a continuous contact around the touch-sensitive surface and can press while dragging (e.g., applying an intensity greater than a "deep press" intensity threshold) to add additional elements to a selection. In this way, a user can intuitively interact with a user interface where pressing harder with a contact causes objects in the user interface to be "stickier."

A number of different approaches to providing an intuitive user interface on a device where a clicking action is decoupled from the force that is needed to reach an activation threshold and/or the device is sensitive to a wide range of contact intensities are described below. Using one or more of these approaches (optionally in conjunction with each other) helps to provide a user interface that intuitively provides users with additional information and functionality, thereby reducing the user's cognitive burden and improving the human-machine interface. Such improvements in the human-machine interface enable users to use the device faster and more efficiently. For battery-operated devices, these improvements conserve power and increase the time between battery charges. For ease of explanation, systems, methods and user interfaces for including illustrative examples of some of these approaches are described below, as follows:

- Many electronic devices have graphical user interfaces with controls which, upon activation, perform various operations at the device. Some controls are linked to more important functions than other controls (e.g., a button in a user interface that allows users to permanently delete user accounts, modify security settings on files or folders, change account passwords, and the like). It would be helpful to provide a user with feedback indicating whether or not a particular control is linked to an important function, for example, by making some controls harder to activate than others. However, when different controls have different activation requirements, the user may be confused as to the requirements to activate a particular control. The embodiments described below provide a convenient and intuitive interface that provides an indication of progress toward activating a control by providing feedback to the user based on intensity of a contact. In particular, FIGS. **5**A-**5**M illustrate exemplary user interfaces for managing activation of controls based on the intensity (e.g., pressure) and/or duration of a contact. FIGS. **6**A-**6**D are flow diagrams illustrating a method of managing activation of controls based on the intensity (e.g., pressure) and/or duration of a contact. The user interfaces in FIGS. **5**A-**5**M are used to illustrate the processes in FIGS. **6**A-**6**D.

Many electronic devices display control icons (e.g., buttons) in a user interface that are responsive to a user input. A cursor is sometimes used to manipulate these controls in response to user input. However, when the input does not include a directional component, the cursor remains stationary while manipulating the controls. The embodiments provide a convenient and intuitive interface for activating controls by, in response to detecting a stationary press input on a touch-sensitive surface changing an appearance of simulated three-dimensional characteristics of a control icon (e.g., the control icon appears to move downward, or be depressed, along a simulated z-axis extending out of the plane of the display) and moving the cursor laterally on the display in accordance with the change in appearance of the control icon. In particular, FIGS. **8**A-**8**K illustrate exemplary user interfaces for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics. FIGS. **9**A-**9**C are flow diagrams illustrating a method of moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics. The user interfaces in FIGS. **8**A-**8**K are used to illustrate the processes in FIGS. **9**A-**9**C.

Many electronic devices include applications in which a user can draw drawings on a virtual canvas. In some situations, the user makes drawings by manipulating a user interface object that corresponds to a virtual drawing instrument (e.g., a virtual brush). The virtual drawing instrument includes one or more properties, associated with output generated from the virtual drawing instrument that are adjustable. However, adjusting these properties frequently involves navigating through a set of menus or controls that can be confusing and time consuming. The embodiments described below provide a more convenient and intuitive interface by enabling the user to adjust an output property of the virtual drawing instrument with the same contact used for manipulating the user interface object that corresponds to the virtual drawing instrument (e.g., by changing an intensity or rotating the contact while manipulating the user interface object that corresponds to the virtual drawing instrument). In particular, FIGS. **11**A-**11**P illustrate exemplary user interfaces for adjusting properties of a virtual brush. FIGS. **12**A-**12**C are flow diagrams illustrating a method of adjusting properties of a virtual brush. The user interfaces in FIGS. **11**A-**11**P are used to illustrate the processes in FIGS. **12**A-**12**C.

Exemplary Devices

Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the various described embodiments. However, it will be apparent to one of ordinary skill in the art that the various described embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, circuits, and networks have not been described in detail so as not to unnecessarily obscure aspects of the embodiments.

It will also be understood that, although the terms first, second, etc. are, in some instances, used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first contact could be termed a second contact, and, similarly, a second contact could be termed a first contact, without departing from the scope of the various described embodiments. The first contact and the second contact are both contacts, but they are not the same contact.

The terminology used in the description of the various described embodiments herein is for the purpose of describing particular embodiments only and is not intended to be limiting. As used in the description of the various described embodiments and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term "and/or" as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms "includes," "including," "comprises," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

As used herein, the term "if" is, optionally, construed to mean "when" or "upon" or "in response to determining" or "in response to detecting," depending on the context. Similarly, the phrase "if it is determined" or "if [a stated condition or event] is detected" is, optionally, construed to mean "upon determining" or "in response to determining" or "upon detecting [the stated condition or event]" or "in response to detecting [the stated condition or event]," depending on the context.

Embodiments of electronic devices, user interfaces for such devices, and associated processes for using such devices are described. In some embodiments, the device is a portable communications device, such as a mobile telephone, that also contains other functions, such as PDA and/or music player functions. Exemplary embodiments of portable multifunction devices include, without limitation, the iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, Calif. Other portable electronic devices, such as laptops or tablet computers with touch-sensitive surfaces (e.g., touch screen displays and/or touch pads), are, optionally, used. It should also be understood that, in some embodiments, the device is not a portable communications device, but is a desktop computer with a touch-sensitive surface (e.g., a touch screen display and/or a touch pad).

In the discussion that follows, an electronic device that includes a display and a touch-sensitive surface is described. It should be understood, however, that the electronic device optionally includes one or more other physical user-interface devices, such as a physical keyboard, a mouse and/or a joystick.

The device typically supports a variety of applications, such as one or more of the following: a drawing application, a presentation application, a word processing application, a website creation application, a disk authoring application, a spreadsheet application, a gaming application, a telephone application, a video conferencing application, an e-mail application, an instant messaging application, a workout support application, a photo management application, a digital camera application, a digital video camera application, a web browsing application, a digital music player application, and/or a digital video player application.

The various applications that are executed on the device optionally use at least one common physical user-interface device, such as the touch-sensitive surface. One or more functions of the touch-sensitive surface as well as corresponding information displayed on the device are, optionally, adjusted and/or varied from one application to the next and/or within a respective application. In this way, a common physical architecture (such as the touch-sensitive surface) of the device optionally supports the variety of applications with user interfaces that are intuitive and transparent to the user.

Attention is now directed toward embodiments of portable devices with touch-sensitive displays. FIG. **1**A is a block diagram illustrating portable multifunction device **100** with touch-sensitive displays **112** in accordance with some embodiments. Touch-sensitive display **112** is sometimes called a "touch screen" for convenience, and is sometimes known as or called a touch-sensitive display system. Device **100** includes memory **102** (which optionally includes one or more computer readable storage mediums), memory controller **122**, one or more processing units (CPU's) **120**, peripherals interface **118**, RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, input/output (I/O) subsystem **106**, other input or control devices **116**, and external port **124**. Device **100** optionally includes one or more optical sensors **164**. Device **100** optionally includes one or more intensity sensors **165** for detecting intensity of contacts on device **100** (e.g., a touch-sensitive surface such as touch-sensitive display system **112** of device **100**). Device **100** optionally includes one or more tactile output generators **167** for generating tactile outputs on device **100** (e.g., generating tactile outputs on a touch-sensitive surface such as touch-sensitive display system **112** of device **100** or touchpad **355** of device **300**). These components optionally communicate over one or more communication buses or signal lines **103**.

As used in the specification and claims, the term "intensity" of a contact on a touch-sensitive surface refers to the force or pressure (force per unit area) of a contact (e.g., a finger contact) on the touch sensitive surface, or to a substitute (proxy) for the force or pressure of a contact on the touch sensitive surface. The intensity of a contact has a range of values that includes at least four distinct values and more typically includes hundreds of distinct values (e.g., at least 256). Intensity of a contact is, optionally, determined (or measured) using various approaches and various sensors or combinations of sensors. For example, one or more force sensors underneath or adjacent to the touch-sensitive surface are, optionally, used to measure force at various points on the touch-sensitive surface. In some implementations, force measurements from multiple force sensors are combined (e.g., a weighted average) to determine an estimated force of a contact. Similarly, a pressure-sensitive tip of a stylus is, optionally, used to determine a pressure of the stylus on the touch-sensitive surface. Alternatively, the size of the contact area detected on the touch-sensitive surface and/or changes thereto, the capacitance of the touch-sensitive surface proximate to the contact and/or changes thereto, and/or the resistance of the touch-sensitive surface proximate to the contact and/or changes thereto are, optionally, used as a substitute for the force or pressure of the contact on the touch-sensitive surface. In some implementations, the substitute measurements for contact force or pressure are used directly to determine whether an intensity threshold has been exceeded (e.g., the intensity threshold is described in units corresponding to the substitute measurements). In some implementations, the substitute measurements for contact force or pressure are converted to an estimated force or pressure and the estimated force or pressure is used to determine whether an intensity threshold has been exceeded (e.g., the intensity threshold is a pressure threshold measured in units of pressure).

As used in the specification and claims, the term "tactile output" refers to physical displacement of a device relative to a previous position of the device, physical displacement of a component (e.g., a touch-sensitive surface) of a device relative to another component (e.g., housing) of the device, or displacement of the component relative to a center of mass of the device that will be detected by a user with the user's sense of touch. For example, in situations where the device or the component of the device is in contact with a surface of a user that is sensitive to touch (e.g., a finger, palm, or other part of a user's hand), the tactile output generated by the physical displacement will be interpreted by the user as a tactile sensation corresponding to a perceived change in physical characteristics of the device or the component of the device. For example, movement of a touch-sensitive surface (e.g., a touch-sensitive display or trackpad) is, optionally, interpreted by the user as a "down click" or "up click" of a physical actuator button. In some cases, a user will feel a tactile sensation such as an "down click" or "up click" even when there is no movement of a physical actuator button associated with the touch-sensitive surface that is physically pressed (e.g., displaced) by the user's movements. As another example, movement of the touch-sensitive surface is, optionally, interpreted or sensed by the user as "roughness" of the touch-sensitive surface, even when there is no change in smoothness of the touch-sensitive surface. While such interpretations of touch by a user will be subject to the individualized sensory perceptions of the user, there are many sensory perceptions of touch that are common to a large majority of users. Thus, when a tactile output is described as corresponding to a particular sensory perception of a user (e.g., an "up click," a "down click," "roughness"), unless otherwise stated, the generated tactile output corresponds to physical displacement of the device or a component thereof that will generate the described sensory perception for a typical (or average) user.

It should be appreciated that device **100** is only one example of a portable multifunction device, and that device **100** optionally has more or fewer components than shown, optionally combines two or more components, or optionally has a different configuration or arrangement of the components. The various components shown in FIG. **1**A are implemented in hardware, software, or a combination of both hardware and software, including one or more signal processing and/or application specific integrated circuits.

Memory **102** optionally includes high-speed random access memory and optionally also includes non-volatile memory, such as one or more magnetic disk storage devices, flash memory devices, or other non-volatile solid-state memory devices. Access to memory **102** by other components of device **100**, such as CPU **120** and the peripherals interface **118**, is, optionally, controlled by memory controller **122**.

Peripherals interface **118** can be used to couple input and output peripherals of the device to CPU **120** and memory **102**. The one or more processors **120** run or execute various software programs and/or sets of instructions stored in memory **102** to perform various functions for device **100** and to process data.

In some embodiments, peripherals interface **118**, CPU **120**, and memory controller **122** are, optionally, implemented on a single chip, such as chip **104**. In some other embodiments, they are, optionally, implemented on separate chips.

RF (radio frequency) circuitry **108** receives and sends RF signals, also called electromagnetic signals. RF circuitry **108** converts electrical signals to/from electromagnetic signals and communicates with communications networks and other communications devices via the electromagnetic signals. RF circuitry **108** optionally includes well-known circuitry for performing these functions, including but not limited to an antenna system, an RF transceiver, one or more amplifiers, a tuner, one or more oscillators, a digital signal processor, a CODEC chipset, a subscriber identity module (SIM) card, memory, and so forth. RF circuitry **108** optionally communicates with networks, such as the Internet, also referred to as the World Wide Web (WWW), an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices by wireless communication. The wireless communication optionally uses any of a plurality of communications standards, protocols and technologies, including but not limited to Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), high-speed downlink packet access (HSDPA), high-speed uplink packet access (HSUPA), Evolution, Data-Only (EV-DO), HSPA, HSPA+, Dual-Cell HSPA (DC-HSPDA), long term evolution (LTE), near field communication (NFC), wideband code division multiple access (W-CDMA), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Wireless Fidelity (Wi-Fi) (e.g., IEEE 802.11a, IEEE 802.11b, IEEE 802.11g and/or IEEE 802.11n), voice over Internet Protocol (VoIP), Wi-MAX, a protocol for e-mail (e.g., Internet message access protocol (IMAP) and/or post office protocol (POP)), instant messaging (e.g., extensible messaging and presence protocol (XMPP), Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions (SIMPLE), Instant Messaging and Presence Service (IMPS)), and/or Short Message Service (SMS), or any other suitable communication protocol, including communication protocols not yet developed as of the filing date of this document.

Audio circuitry **110**, speaker **111**, and microphone **113** provide an audio interface between a user and device **100**. Audio circuitry **110** receives audio data from peripherals interface **118**, converts the audio data to an electrical signal, and transmits the electrical signal to speaker **111**. Speaker **111** converts the electrical signal to human-audible sound waves. Audio circuitry **110** also receives electrical signals converted by microphone **113** from sound waves. Audio circuitry **110** converts the electrical signal to audio data and transmits the audio data to peripherals interface **118** for processing. Audio data is, optionally, retrieved from and/or transmitted to memory **102** and/or RF circuitry **108** by peripherals interface **118**. In some embodiments, audio circuitry **110** also includes a headset jack (e.g., **212**, FIG. **2**). The headset jack provides an interface between audio circuitry **110** and removable audio input/output peripherals, such as output-only headphones or a headset with both output (e.g., a headphone for one or both ears) and input (e.g., a microphone).

I/O subsystem **106** couples input/output peripherals on device **100**, such as touch screen **112** and other input control devices **116**, to peripherals interface **118**. I/O subsystem **106** optionally includes display controller **156**, optical sensor controller **158**, intensity sensor controller **159**, haptic feedback controller **161** and one or more input controllers **160** for other input or control devices. The one or more input controllers **160** receive/send electrical signals from/to other input or control devices **116**. The other input control devices **116** optionally include physical buttons (e.g., push buttons, rocker buttons, etc.), dials, slider switches, joysticks, click wheels, and so forth. In some alternate embodiments, input controller(s) **160** are, optionally, coupled to any (or none) of the following: a keyboard, infrared port, USB port, and a pointer device such as a mouse. The one or more buttons (e.g., **208**, FIG. **2**) optionally include an up/down button for volume control of speaker **111** and/or microphone **113**. The one or more buttons optionally include a push button (e.g., **206**, FIG. **2**).

Touch-sensitive display **112** provides an input interface and an output interface between the device and a user. Display controller **156** receives and/or sends electrical signals from/to touch screen **112**. Touch screen **112** displays visual output to the user. The visual output optionally includes graphics, text, icons, video, and any combination thereof (collectively termed "graphics"). In some embodiments, some or all of the visual output corresponds to user-interface objects.

Touch screen **112** has a touch-sensitive surface, sensor or set of sensors that accepts input from the user based on haptic and/or tactile contact. Touch screen **112** and display controller **156** (along with any associated modules and/or sets of instructions in memory **102**) detect contact (and any movement or breaking of the contact) on touch screen **112** and converts the detected contact into interaction with user-interface objects (e.g., one or more soft keys, icons, web pages or images) that are displayed on touch screen **112**. In an exemplary embodiment, a point of contact between touch screen **112** and the user corresponds to a finger of the user.

Touch screen **112** optionally uses LCD (liquid crystal display) technology, LPD (light emitting polymer display) technology, or LED (light emitting diode) technology, although other display technologies are used in other embodiments. Touch screen **112** and display controller **156** optionally detect contact and any movement or breaking thereof using any of a plurality of touch sensing technologies now known or later developed, including but not limited to capacitive, resistive, infrared, and surface acoustic wave technologies, as well as other proximity sensor arrays or other elements for determining one or more points of contact with touch screen **112**. In an exemplary embodiment, projected mutual capacitance sensing technology is used, such as that found in the iPhone®, iPod Touch®, and iPad® from Apple Inc. of Cupertino, Calif.

Touch screen **112** optionally has a video resolution in excess of 100 dpi. In some embodiments, the touch screen has a video resolution of approximately 160 dpi. The user optionally makes contact with touch screen **112** using any suitable object or appendage, such as a stylus, a finger, and so forth. In some embodiments, the user interface is designed to work primarily with finger-based contacts and gestures, which can be less precise than stylus-based input due to the larger area of contact of a finger on the touch screen. In some embodiments, the device translates the rough finger-based input into a precise pointer/cursor position or command for performing the actions desired by the user.

In some embodiments, in addition to the touch screen, device **100** optionally includes a touchpad (not shown) for activating or deactivating particular functions. In some embodiments, the touchpad is a touch-sensitive area of the device that, unlike the touch screen, does not display visual output. The touchpad is, optionally, a touch-sensitive surface that is separate from touch screen **112** or an extension of the touch-sensitive surface formed by the touch screen.

Device **100** also includes power system **162** for powering the various components. Power system **162** optionally includes a power management system, one or more power sources (e.g., battery, alternating current (AC)), a recharging system, a power failure detection circuit, a power converter or inverter, a power status indicator (e.g., a light-emitting diode (LED)) and any other components associated with the generation, management and distribution of power in portable devices.

Device **100** optionally also includes one or more optical sensors **164**. FIG. **1**A shows an optical sensor coupled to optical sensor controller **158** in I/O subsystem **106**. Optical sensor **164** optionally includes charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) phototransistors. Optical sensor **164** receives light from the environment, projected through one or more lens, and converts the light to data representing an image. In conjunction with imaging module **143** (also called a camera module), optical sensor **164** optionally captures still images or video. In some embodiments, an optical sensor is located on the back of device **100**, opposite touch screen display **112** on the front of the device, so that the touch screen display is enabled for use as a viewfinder for still and/or video image acquisition. In some embodiments, another optical sensor is located on the front of the device so that the user's image is, optionally, obtained for videoconferencing while the user views the other video conference participants on the touch screen display.

Device **100** optionally also includes one or more contact intensity sensors **165**. FIG. **1**A shows a contact intensity sensor coupled to intensity sensor controller **159** in I/O subsystem **106**. Contact intensity sensor **165** optionally includes one or more piezoresistive strain gauges, capacitive force sensors, electric force sensors, piezoelectric force sensors, optical force sensors, capacitive touch-sensitive surfaces, or other intensity sensors (e.g., sensors used to measure the force (or pressure) of a contact on a touch-sensitive surface). Contact intensity sensor **165** receives contact intensity information (e.g., pressure information or a proxy for pressure information) from the environment. In some embodiments, at least one contact intensity sensor is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **112**). In some embodiments, at least one contact intensity sensor is located on the back of device **100**, opposite touch screen display **112** which is located on the front of device **100**.

Device **100** optionally also includes one or more proximity sensors **166**. FIG. **1**A shows proximity sensor **166** coupled to peripherals interface **118**. Alternately, proximity sensor **166** is coupled to input controller **160** in I/O subsystem **106**. In some embodiments, the proximity sensor turns off and disables touch screen **112** when the multifunction device is placed near the user's ear (e.g., when the user is making a phone call).

Device **100** optionally also includes one or more tactile output generators **167**. FIG. **1**A shows a tactile output generator coupled to haptic feedback controller **161** in I/O subsystem **106**. Tactile output generator **167** optionally includes one or more electroacoustic devices such as speakers or other audio components and/or electromechanical devices that convert energy into linear motion such as a motor, solenoid, electroactive polymer, piezoelectric actuator, electrostatic actuator, or other tactile output generating component (e.g., a component that converts electrical signals into tactile outputs on the device). Contact intensity sensor **165** receives tactile feedback generation instructions from haptic feedback module **133** and generates tactile outputs on device **100** that are capable of being sensed by a user of device **100**. In some embodiments, at least one tactile output generator is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **112**) and, optionally, generates a tactile output by moving the touch-sensitive surface vertically (e.g., in/out of a surface of device **100**) or laterally (e.g., back and forth in the same plane as a surface of device **100**). In some embodiments, at least one tactile output generator sensor is located on the back of device **100**, opposite touch screen display **112** which is located on the front of device **100**.

Device **100** optionally also includes one or more accelerometers **168**. FIG. **1**A shows accelerometer **168** coupled to peripherals interface **118**. Alternately, accelerometer **168** is, optionally, coupled to an input controller **160** in I/O subsystem **106**. In some embodiments, information is displayed on the touch screen display in a portrait view or a landscape view based on an analysis of data received from the one or more accelerometers. Device **100** optionally includes, in addition to accelerometer(s) **168**, a magnetometer (not shown) and a GPS (or GLONASS or other global navigation system) receiver (not shown) for obtaining information concerning the location and orientation (e.g., portrait or landscape) of device **100**.

In some embodiments, the software components stored in memory **102** include operating system **126**, communication module (or set of instructions) **128**, contact/motion module (or set of instructions) **130**, graphics module (or set of instructions) **132**, text input module (or set of instructions) **134**, Global Positioning System (GPS) module (or set of instructions) **135**, and applications (or sets of instructions) **136**. Furthermore, in some embodiments memory **102** stores device/global internal state **157**, as shown in FIGS. **1**A and **3**. Device/global internal state **157** includes one or more of: active application state, indicating which applications, if any, are currently active; display state, indicating what applications, views or other information occupy various regions of touch screen display **112**; sensor state, including information obtained from the device's various sensors and input control devices **116**; and location information concerning the device's location and/or attitude.

Operating system **126** (e.g., Darwin, RTXC, LINUX, UNIX, OS X, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communication between various hardware and software components.

Communication module **128** facilitates communication with other devices over one or more external ports **124** and also includes various software components for handling data received by RF circuitry **108** and/or external port **124**. External port **124** (e.g., Universal Serial Bus (USB), FIREWIRE, etc.) is adapted for coupling directly to other devices or indirectly over a network (e.g., the Internet, wireless LAN, etc.). In some embodiments, the external port is a multi-pin (e.g., 30-pin) connector that is the same as, or similar to and/or compatible with the 30-pin connector used on iPod (trademark of Apple Inc.) devices.

Contact/motion module **130** optionally detects contact with touch screen **112** (in conjunction with display controller **156**) and other touch sensitive devices (e.g., a touchpad or physical click wheel). Contact/motion module **130** includes various software components for performing various operations related to detection of contact, such as determining if contact has occurred (e.g., detecting a finger-down event), determining an intensity of the contact (e.g., the force or pressure of the contact or a substitute for the force or pressure of the contact) determining if there is movement of the contact and tracking the movement across the touch-sensitive surface (e.g., detecting one or more finger-dragging events), and determining if the contact has ceased (e.g., detecting a finger-up event or a break in contact). Contact/motion module **130** receives contact data from the touch-sensitive surface. Determining movement of the point of contact, which is represented by a series of contact data, optionally includes determining speed (magnitude), velocity (magnitude and direction), and/or an acceleration (a change in magnitude and/or direction) of the point of contact. These operations are, optionally, applied to single contacts (e.g., one finger contacts) or to multiple simultaneous contacts (e.g., "multitouch"/multiple finger contacts). In some embodiments, contact/motion module **130** and display controller **156** detect contact on a touchpad.

In some embodiments, contact/motion module **130** uses a set of one or more intensity thresholds to determine whether an operation has been performed by a user (e.g., to determine whether a user has "clicked" on an icon). In some embodiments at least a subset of the intensity thresholds are determined in accordance with software parameters (e.g., the intensity thresholds are not determined by the activation thresholds of particular physical actuators and can be adjusted without changing the physical hardware of device **100**). For example, a mouse "click" threshold of a trackpad or touch screen display can be set to any of a large range of predefined thresholds values without changing the trackpad or touch screen display hardware. Additionally, in some implementations a user of the device is provided with software settings for adjusting one or more of the set of intensity thresholds (e.g., by adjusting individual intensity thresholds and/or by adjusting a plurality of intensity thresholds at once with a system-level click "intensity" parameter).

Contact/motion module **130** optionally detects a gesture input by a user. Different gestures on the touch-sensitive surface have different contact patterns and intensities. Thus, a gesture is, optionally, detected by detecting a particular contact pattern. For example, detecting a finger tap gesture includes detecting a finger-down event followed by detecting a finger-up (lift off) event at the same position (or substantially the same position) as the finger-down event (e.g., at the position of an icon). As another example, detecting a finger swipe gesture on the touch-sensitive surface includes detecting a finger-down event followed by detecting one or more finger-dragging events, and subsequently followed by detecting a finger-up (lift off) event.

Graphics module **132** includes various known software components for rendering and displaying graphics on touch screen **112** or other display, including components for changing the visual impact (e.g., brightness, transparency, saturation, contrast or other visual property) of graphics that are displayed. As used herein, the term "graphics" includes any object that can be displayed to a user, including without limitation text, web pages, icons (such as user-interface objects including soft keys), digital images, videos, animations and the like.

In some embodiments, graphics module **132** stores data representing graphics to be used. Each graphic is, optionally, assigned a corresponding code. Graphics module **132** receives, from applications etc., one or more codes specifying graphics to be displayed along with, if necessary, coordinate data and other graphic property data, and then generates screen image data to output to display controller **156**.

Haptic feedback module **133** includes various software components for generating instructions used by tactile output generator(s) **167** to produce tactile outputs at one or more locations on device **100** in response to user interactions with device **100**.

Text input module **134**, which is, optionally, a component of graphics module **132**, provides soft keyboards for entering text in various applications (e.g., contacts **137**, e-mail **140**, IM **141**, browser **147**, and any other application that needs text input).

GPS module **135** determines the location of the device and provides this information for use in various applications (e.g., to telephone **138** for use in location-based dialing, to camera **143** as picture/video metadata, and to applications that provide location-based services such as weather widgets, local yellow page widgets, and map/navigation widgets).

Applications **136** optionally include the following modules (or sets of instructions), or a subset or superset thereof:

- contacts module **137** (sometimes called an address book or contact list);
- telephone module **138**;
- video conferencing module **139**;
- e-mail client module **140**;
- instant messaging (IM) module **141**;
- workout support module **142**;
- camera module **143** for still and/or video images;
- image management module **144**;
- browser module **147**;
- calendar module **148**;
- widget modules **149**, which optionally include one or more of: weather widget **149-1**, stocks widget **149-2**, calculator widget **149-3**, alarm clock widget **149-4**, dictionary widget **149-5**, and other widgets obtained by the user, as well as user-created widgets **149-6**;
- widget creator module **150** for making user-created widgets **149-6**;
- search module **151**;
- video and music player module **152**, which is, optionally, made up of a video player module and a music player module;
- notes module **153**;
- map module **154**; and/or
- online video module **155**.

Examples of other applications **136** that are, optionally, stored in memory **102** include other word processing applications, other image editing applications, drawing applications, presentation applications, JAVA-enabled applications, encryption, digital rights management, voice recognition, and voice replication.

In conjunction with touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, contacts module **137** are, optionally, used to manage an address book or contact list (e.g., stored in application internal state **192** of contacts module **137** in memory **102** or memory **370**), including: adding name(s) to the address book; deleting name(s) from the address book; associating telephone number(s), e-mail address(es), physical address(es) or other information with a name; associating an image with a name; categorizing and sorting names; providing telephone numbers or e-mail addresses to initiate and/or facilitate communications by telephone **138**, video conference **139**, e-mail **140**, or IM **141**; and so forth.

In conjunction with RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, telephone module **138** are, optionally, used to enter a sequence of characters corresponding to a telephone number, access one or more telephone numbers in address book **137**, modify a telephone number that has been entered, dial a respective telephone number, conduct a conversation and disconnect or hang up when the conversation is completed. As noted above, the wireless communication optionally uses any of a plurality of communications standards, protocols and technologies.

In conjunction with RF circuitry **108**, audio circuitry **110**, speaker **111**, microphone **113**, touch screen **112**, display controller **156**, optical sensor **164**, optical sensor controller **158**, contact module **130**, graphics module **132**, text input module **134**, contact list **137**, and telephone module **138**, videoconferencing module **139** includes executable instructions to initiate, conduct, and terminate a video conference between a user and one or more other participants in accordance with user instructions.

In conjunction with RF circuitry **108**, touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, e-mail client module **140** includes executable instructions to create, send, receive, and manage e-mail in response to user instructions. In conjunction with image management module **144**, e-mail client module **140** makes it very easy to create and send e-mails with still or video images taken with camera module **143**.

In conjunction with RF circuitry **108**, touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, the instant messaging module **141** includes executable instructions to enter a sequence of characters corresponding to an instant message, to modify previously entered characters, to transmit a respective instant message (for example, using a Short Message Service (SMS) or Multimedia Message Service (MMS) protocol for telephony-based instant messages or using XMPP, SIMPLE, or IMPS for Internet-based instant messages), to receive instant messages and to view received instant messages. In some embodiments, transmitted and/or received instant messages optionally include graphics, photos, audio files, video files and/or other attachments as are supported in a MMS and/or an Enhanced Messaging Service (EMS). As used herein, "instant messaging" refers to both telephony-based messages (e.g., messages sent using SMS or MMS) and Internet-based messages (e.g., messages sent using XMPP, SIMPLE, or IMPS).

In conjunction with RF circuitry **108**, touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, text input module **134**, GPS module **135**, map module **154**, and music player module **146**, workout support module **142** includes executable instructions to create workouts (e.g., with time, distance, and/or calorie burning goals); communicate with workout sensors (sports devices); receive workout sensor data; calibrate sensors used to monitor a workout; select and play music for a workout; and display, store and transmit workout data.

In conjunction with touch screen **112**, display controller **156**, optical sensor(s) **164**, optical sensor controller **158**, contact module **130**, graphics module **132**, and image management module **144**, camera module **143** includes executable instructions to capture still images or video (including a video stream) and store them into memory **102**, modify characteristics of a still image or video, or delete a still image or video from memory **102**.

In conjunction with touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, text input module **134**, and camera module **143**, image management module **144** includes executable instructions to arrange, modify (e.g., edit), or otherwise manipulate, label, delete, present (e.g., in a digital slide show or album), and store still and/or video images.

In conjunction with RF circuitry **108**, touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, and text input module **134**, browser module **147** includes executable instructions to browse the Internet in accordance with user instructions, including searching, linking to, receiving, and displaying web pages or portions thereof, as well as attachments and other files linked to web pages.

In conjunction with RF circuitry **108**, touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, e-mail client module **140**, and browser module **147**, calendar module **148** includes executable instructions to create, display, modify, and store calendars and data associated with calendars (e.g., calendar entries, to do lists, etc.) in accordance with user instructions.

In conjunction with RF circuitry **108**, touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, and browser module **147**, widget modules **149** are mini-applications that are, optionally, downloaded and used by a user (e.g., weather widget **149-1**, stocks widget **149-2**, calculator widget **149-3**, alarm clock widget **149-4**, and dictionary widget **149-5**) or created by the user (e.g., user-created widget **149-6**). In some embodiments, a widget includes an HTML (Hypertext Markup Language) file, a CSS (Cascading Style Sheets) file, and a JavaScript file. In some embodiments, a widget includes an XML (Extensible Markup Language) file and a JavaScript file (e.g., Yahoo! Widgets).

In conjunction with RF circuitry **108**, touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, and browser module **147**, the widget creator module **150** are, optionally, used by a user to create widgets (e.g., turning a user-specified portion of a web page into a widget).

In conjunction with touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, and text input module **134**, search module **151** includes executable instructions to search for text, music, sound, image, video, and/or other files in memory **102** that match one or more search criteria (e.g., one or more user-specified search terms) in accordance with user instructions.

In conjunction with touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, audio circuitry **110**, speaker **111**, RF circuitry **108**, and browser module **147**, video and music player module **152** includes executable instructions that allow the user to download and play back recorded music and other sound files stored in one or more file formats, such as MP3 or AAC files, and executable instructions to display, present or otherwise play back videos (e.g., on touch screen **112** or on an external, connected display via external port **124**). In some embodiments, device **100** optionally includes the functionality of an MP3 player, such as an iPod (trademark of Apple Inc.).

In conjunction with touch screen **112**, display controller **156**, contact module **130**, graphics module **132**, and text input module **134**, notes module **153** includes executable instructions to create and manage notes, to do lists, and the like in accordance with user instructions.

In conjunction with RF circuitry **108**, touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, text input module **134**, GPS module **135**, and browser module **147**, map module **154** are, optionally, used to receive, display, modify, and store maps and data associated with maps (e.g., driving directions; data on stores and other points of interest at or near a particular location; and other location-based data) in accordance with user instructions.

In conjunction with touch screen **112**, display system controller **156**, contact module **130**, graphics module **132**, audio circuitry **110**, speaker **111**, RF circuitry **108**, text input module **134**, e-mail client module **140**, and browser module **147**, online video module **155** includes instructions that allow the user to access, browse, receive (e.g., by streaming and/or download), play back (e.g., on the touch screen or on an external, connected display via external port **124**), send an e-mail with a link to a particular online video, and otherwise manage online videos in one or more file formats, such as H.264. In some embodiments, instant messaging module **141**, rather than e-mail client module **140**, is used to send a link to a particular online video.

Each of the above identified modules and applications correspond to a set of executable instructions for performing one or more functions described above and the methods described in this application (e.g., the computer-implemented methods and other information processing methods described herein). These modules (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some embodiments, memory **102** optionally stores a subset of the modules and data structures identified above. Furthermore, memory **102** optionally stores additional modules and data structures not described above.

In some embodiments, device **100** is a device where operation of a predefined set of functions on the device is performed exclusively through a touch screen and/or a touchpad. By using a touch screen and/or a touchpad as the primary input control device for operation of device **100**, the number of physical input control devices (such as push buttons, dials, and the like) on device **100** is, optionally, reduced.

The predefined set of functions that are performed exclusively through a touch screen and/or a touchpad optionally include navigation between user interfaces. In some embodiments, the touchpad, when touched by the user, navigates device **100** to a main, home, or root menu from any user interface that is displayed on device **100**. In such embodiments, a "menu button" is implemented using a touchpad. In some other embodiments, the menu button is a physical push button or other physical input control device instead of a touchpad.

FIG. **1**B is a block diagram illustrating exemplary components for event handling in accordance with some embodiments. In some embodiments, memory **102** (in FIG. 1A) or **370** (FIG. **3**) includes event sorter **170** (e.g., in operating system **126**) and a respective application **136-1** (e.g., any of the aforementioned applications **137-151**, **155**, **380-390**).

Event sorter **170** receives event information and determines the application **136-1** and application view **191** of application **136-1** to which to deliver the event information. Event sorter **170** includes event monitor **171** and event dispatcher module **174**. In some embodiments, application **136-1** includes application internal state **192**, which indicates the current application view(s) displayed on touch sensitive display **112** when the application is active or executing. In some embodiments, device/global internal state **157** is used by event sorter **170** to determine which application(s) is (are) currently active, and application internal state **192** is used by event sorter **170** to determine application views **191** to which to deliver event information.

In some embodiments, application internal state **192** includes additional information, such as one or more of: resume information to be used when application **136-1** resumes execution, user interface state information that indicates information being displayed or that is ready for display by application **136-1**, a state queue for enabling the user to go back to a prior state or view of application **136-1**, and a redo/undo queue of previous actions taken by the user.

Event monitor **171** receives event information from peripherals interface **118**. Event information includes information about a sub-event (e.g., a user touch on touch-sensitive display **112**, as part of a multi-touch gesture). Peripherals interface **118** transmits information it receives from I/O subsystem **106** or a sensor, such as proximity sensor **166**, accelerometer(s) **168**, and/or microphone **113** (through audio circuitry **110**). Information that peripherals interface **118** receives from I/O subsystem **106** includes information from touch-sensitive display **112** or a touch-sensitive surface.

In some embodiments, event monitor **171** sends requests to the peripherals interface **118** at predetermined intervals. In response, peripherals interface **118** transmits event information. In other embodiments, peripheral interface **118** transmits event information only when there is a significant event (e.g., receiving an input above a predetermined noise threshold and/or for more than a predetermined duration).

In some embodiments, event sorter **170** also includes a hit view determination module **172** and/or an active event recognizer determination module **173**.

Hit view determination module **172** provides software procedures for determining where a sub-event has taken place within one or more views, when touch sensitive display **112** displays more than one view. Views are made up of controls and other elements that a user can see on the display.

Another aspect of the user interface associated with an application is a set of views, sometimes herein called application views or user interface windows, in which information is displayed and touch-based gestures occur. The application views (of a respective application) in which a touch is detected optionally correspond to programmatic levels within a programmatic or view hierarchy of the application. For example, the lowest level view in which a touch is detected is, optionally, called the hit view, and the set of events that are recognized as proper inputs are, optionally, determined based, at least in part, on the hit view of the initial touch that begins a touch-based gesture.

Hit view determination module **172** receives information related to sub-events of a touch-based gesture. When an application has multiple views organized in a hierarchy, hit view determination module **172** identifies a hit view as the lowest view in the hierarchy which should handle the sub-event. In most circumstances, the hit view is the lowest level view in which an initiating sub-event occurs (i.e., the first sub-event in the sequence of sub-events that form an event or potential event). Once the hit view is identified by the hit view determination module, the hit view typically receives all sub-events related to the same touch or input source for which it was identified as the hit view.

Active event recognizer determination module **173** determines which view or views within a view hierarchy should receive a particular sequence of sub-events. In some embodiments, active event recognizer determination module **173** determines that only the hit view should receive a particular sequence of sub-events. In other embodiments, active event recognizer determination module **173** determines that all views that include the physical location of a sub-event are actively involved views, and therefore determines that all actively involved views should receive a particular sequence of sub-events. In other embodiments, even if touch sub-events were entirely confined to the area associated with one particular view, views higher in the hierarchy would still remain as actively involved views.

Event dispatcher module **174** dispatches the event information to an event recognizer (e.g., event recognizer **180**). In embodiments including active event recognizer determination module **173**, event dispatcher module **174** delivers the event information to an event recognizer determined by active event recognizer determination module **173**. In some embodiments, event dispatcher module **174** stores in an event queue the event information, which is retrieved by a respective event receiver module **182**.

In some embodiments, operating system **126** includes event sorter **170**. Alternatively, application **136-1** includes event sorter **170**. In yet other embodiments, event sorter **170** is a stand-alone module, or a part of another module stored in memory **102**, such as contact/motion module **130**.

In some embodiments, application **136-1** includes a plurality of event handlers **190** and one or more application views **191**, each of which includes instructions for handling touch events that occur within a respective view of the application's user interface. Each application view **191** of the application **136-1** includes one or more event recognizers **180**. Typically, a respective application view **191** includes a plurality of event recognizers **180**. In other embodiments, one or more of event recognizers **180** are part of a separate module, such as a user interface kit (not shown) or a higher level object from which application **136-1** inherits methods and other properties. In some embodiments, a respective event handler **190** includes one or more of: data updater **176**, object updater **177**, GUI updater **178**, and/or event data **179** received from event sorter **170**. Event handler **190** optionally utilizes or calls data updater **176**, object updater **177** or GUI updater **178** to update the application internal state **192**. Alternatively, one or more of the application views **191** includes one or more respective event handlers **190**. Also, in some embodiments, one or more of data updater **176**, object updater **177**, and GUI updater **178** are included in a respective application view **191**.

A respective event recognizer **180** receives event information (e.g., event data **179**) from event sorter **170**, and identifies an event from the event information. Event recognizer **180** includes event receiver **182** and event comparator **184**. In some embodiments, event recognizer **180** also includes at least a subset of: metadata **183**, and event delivery instructions **188** (which optionally include sub-event delivery instructions).

Event receiver **182** receives event information from event sorter **170**. The event information includes information about a sub-event, for example, a touch or a touch movement. Depending on the sub-event, the event information also includes additional information, such as location of the sub-event. When the sub-event concerns motion of a touch, the event information optionally also includes speed and direction of the sub-event. In some embodiments, events include rotation of the device from one orientation to another (e.g., from a portrait orientation to a landscape orientation, or vice versa), and the event information includes corresponding information about the current orientation (also called device attitude) of the device.

Event comparator **184** compares the event information to predefined event or sub-event definitions and, based on the comparison, determines an event or sub-event, or determines or updates the state of an event or sub-event. In some embodiments, event comparator **184** includes event definitions **186**. Event definitions **186** contain definitions of events (e.g., predefined sequences of sub-events), for example, event 1 (**187-1**), event 2 (**187-2**), and others. In some embodiments, sub-events in an event **187** include, for example, touch begin, touch end, touch movement, touch cancellation, and multiple touching. In one example, the definition for event 1 (**187-1**) is a double tap on a displayed object. The double tap, for example, comprises a first touch (touch begin) on the displayed object for a predetermined phase, a first lift-off (touch end) for a predetermined phase, a second touch (touch begin) on the displayed object for a predetermined phase, and a second lift-off (touch end) for a predetermined phase. In another example, the definition for event 2 (**187-2**) is a dragging on a displayed object. The dragging, for example, comprises a touch (or contact) on the displayed object for a predetermined phase, a movement of the touch across touch-sensitive display **112**, and lift-off of the touch (touch end). In some embodiments, the event also includes information for one or more associated event handlers **190**.

In some embodiments, event definition **187** includes a definition of an event for a respective user-interface object. In some embodiments, event comparator **184** performs a hit test to determine which user-interface object is associated with a sub-event. For example, in an application view in which three user-interface objects are displayed on touch-sensitive display **112**, when a touch is detected on touch-sensitive display **112**, event comparator **184** performs a hit test to determine which of the three user-interface objects is associated with the touch (sub-event). If each displayed object is associated with a respective event handler **190**, the event comparator uses the result of the hit test to determine which event handler **190** should be activated. For example, event comparator **184** selects an event handler associated with the sub-event and the object triggering the hit test.

In some embodiments, the definition for a respective event **187** also includes delayed actions that delay delivery of the event information until after it has been determined whether the sequence of sub-events does or does not correspond to the event recognizer's event type.

When a respective event recognizer **180** determines that the series of sub-events do not match any of the events in event definitions **186**, the respective event recognizer **180** enters an event impossible, event failed, or event ended state, after which it disregards subsequent sub-events of the touch-based gesture. In this situation, other event recognizers, if any, that remain active for the hit view continue to track and process sub-events of an ongoing touch-based gesture.

In some embodiments, a respective event recognizer **180** includes metadata **183** with configurable properties, flags, and/or lists that indicate how the event delivery system should perform sub-event delivery to actively involved event recognizers. In some embodiments, metadata **183** includes configurable properties, flags, and/or lists that indicate how event recognizers interact, or are enabled to interact, with one another. In some embodiments, metadata **183** includes configurable properties, flags, and/or lists that indicate whether sub-events are delivered to varying levels in the view or programmatic hierarchy.

In some embodiments, a respective event recognizer **180** activates event handler **190** associated with an event when one or more particular sub-events of an event are recognized. In some embodiments, a respective event recognizer **180** delivers event information associated with the event to event handler **190**. Activating an event handler **190** is distinct from sending (and deferred sending) sub-events to a respective hit view. In some embodiments, event recognizer **180** throws a flag associated with the recognized event, and event handler **190** associated with the flag catches the flag and performs a predefined process.

In some embodiments, event delivery instructions **188** include sub-event delivery instructions that deliver event information about a sub-event without activating an event handler. Instead, the sub-event delivery instructions deliver event information to event handlers associated with the series of sub-events or to actively involved views. Event handlers associated with the series of sub-events or with actively involved views receive the event information and perform a predetermined process.

In some embodiments, data updater **176** creates and updates data used in application **136-1**. For example, data updater **176** updates the telephone number used in contacts module **137**, or stores a video file used in video player module **145**. In some embodiments, object updater **177** creates and updates objects used in application **136-1**. For example, object updater **177** creates a new user-interface object or updates the position of a user-interface object. GUI updater **178** updates the GUI. For example, GUI updater **178** prepares display information and sends it to graphics module **132** for display on a touch-sensitive display.

In some embodiments, event handler(s) **190** includes or has access to data updater **176**, object updater **177**, and GUI updater **178**. In some embodiments, data updater **176**, object updater **177**, and GUI updater **178** are included in a single module of a respective application **136-1** or application view **191**. In other embodiments, they are included in two or more software modules.

It shall be understood that the foregoing discussion regarding event handling of user touches on touch-sensitive displays also applies to other forms of user inputs to operate multifunction devices **100** with input-devices, not all of which are initiated on touch screens. For example, mouse movement and mouse button presses, optionally coordinated with single or multiple keyboard presses or holds; contact movements such as taps, drags, scrolls, etc., on touch-pads; pen stylus inputs; movement of the device; oral instructions; detected eye movements; biometric inputs; and/or any combination thereof are optionally utilized as inputs corresponding to sub-events which define an event to be recognized.

FIG. **2** illustrates a portable multifunction device **100** having a touch screen **112** in accordance with some embodiments. The touch screen optionally displays one or more graphics within user interface (UI) **200**. In this embodiment, as well as others described below, a user is enabled to select one or more of the graphics by making a gesture on the graphics, for example, with one or more fingers **202** (not drawn to scale in the figure) or one or more styluses **203** (not drawn to scale in the figure). In some embodiments, selection of one or more graphics occurs when the user breaks contact with the one or more graphics. In some embodiments, the gesture optionally includes one or more taps, one or more swipes (from left to right, right to left, upward and/or downward) and/or a rolling of a finger (from right to left, left to right, upward and/or downward) that has made contact with device **100**. In some implementations or circumstances, inadvertent contact with a graphic does not select the graphic. For example, a swipe gesture that sweeps over an application icon optionally does not select the corresponding application when the gesture corresponding to selection is a tap.

Device **100** optionally also includes one or more physical buttons, such as "home" or menu button **204**. As described previously, menu button **204** is, optionally, used to navigate to any application **136** in a set of applications that are, optionally executed on device **100**. Alternatively, in some embodiments, the menu button is implemented as a soft key in a GUI displayed on touch screen **112**.

In one embodiment, device **100** includes touch screen **112**, menu button **204**, push button **206** for powering the device on/off and locking the device, volume adjustment button(s) **208**, Subscriber Identity Module (SIM) card slot **210**, head set jack **212**, and docking/charging external port **124**. Push button **206** is, optionally, used to turn the power on/off on the device by depressing the button and holding the button in the depressed state for a predefined time interval; to lock the device by depressing the button and releasing the button before the predefined time interval has elapsed; and/or to unlock the device or initiate an unlock process. In an alternative embodiment, device **100** also accepts verbal input for activation or deactivation of some functions through microphone **113**. Device **100** also, optionally, includes one or more contact intensity sensors **165** for detecting intensity of contacts on touch screen **112** and/or one or more tactile output generators **167** for generating tactile outputs for a user of device **100**.

FIG. **3** is a block diagram of an exemplary multifunction device with a display and a touch-sensitive surface in accordance with some embodiments. Device **300** need not be portable. In some embodiments, device **300** is a laptop computer, a desktop computer, a tablet computer, a multimedia player device, a navigation device, an educational device (such as a child's learning toy), a gaming system, or a control device (e.g., a home or industrial controller). Device **300** typically includes one or more processing units (CPU's) **310**, one or more network or other communications interfaces **360**, memory **370**, and one or more communication buses **320** for interconnecting these components. Communication buses **320** optionally include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. Device **300** includes input/output (I/O) interface **330** comprising display **340**, which is typically a touch screen display. I/O interface **330** also optionally includes a keyboard and/or mouse (or other pointing device) **350** and touchpad **355**, tactile output generator **357** for generating tactile outputs on device **300** (e.g., similar to tactile output generator(s) **167** described above with reference to FIG. **1A**), sensors **359** (e.g., optical, acceleration, proximity, touch-sensitive, and/or contact intensity sensors similar to contact intensity sensor(s) **165** described above with reference to FIG. **1**A). Memory **370** includes high-speed random access memory, such as DRAM, SRAM, DDR RAM or other random access solid state memory devices; and optionally includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid state storage devices. Memory **370** optionally includes one or more storage devices remotely located from CPU(s) **310**. In some embodiments, memory **370** stores programs, modules, and data structures analogous to the programs, modules, and data structures stored in memory **102** of portable multifunction device **100** (FIG. **1**A), or a subset thereof. Furthermore, memory **370** optionally stores additional programs, modules, and data structures not present in memory **102** of portable multifunction device **100**. For example, memory **370** of device **300** optionally stores drawing module **380**, presentation module **382**, word processing module **384**, website creation module **386**, disk authoring module **388**, and/or spreadsheet module **390**, while memory **102** of portable multifunction device **100** (FIG. **1**A) optionally does not store these modules.

Each of the above identified elements in FIG. **3** are, optionally, stored in one or more of the previously mentioned memory devices. Each of the above identified modules corresponds to a set of instructions for performing a function described above. The above identified modules or programs (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some embodiments, memory **370** optionally stores a subset of the modules and data structures identified above. Furthermore, memory **370** optionally stores additional modules and data structures not described above.

Attention is now directed towards embodiments of user interfaces ("UI") that is, optionally, implemented on portable multifunction device **100**.

FIG. **4**A illustrates an exemplary user interface for a menu of applications on portable multifunction device **100** in accordance with some embodiments. Similar user interfaces are, optionally, implemented on device **300**. In some embodiments, user interface **400** includes the following elements, or a subset or superset thereof:

- Signal strength indicator(s) **402** for wireless communication(s), such as cellular and Wi-Fi signals;
- Time **404**;
- Bluetooth indicator **405**;
- Battery status indicator **406**;
- Tray **408** with icons for frequently used applications, such as:
  - Icon **416** for telephone module **138**, labeled "Phone," which optionally includes an indicator **414** of the number of missed calls or voicemail messages;
  - Icon **418** for e-mail client module **140**, labeled "Mail," which optionally includes an indicator **410** of the number of unread e-mails;
  - Icon **420** for browser module **147**, labeled "Browser;" and
  - Icon **422** for video and music player module **152**, also referred to as iPod (trademark of Apple Inc.) module **152**, labeled "iPod;" and
- Icons for other applications, such as:
  - Icon **424** for IM module **141**, labeled "Text;"
  - Icon **426** for calendar module **148**, labeled "Calendar;"
  - Icon **428** for image management module **144**, labeled "Photos;"
  - Icon **430** for camera module **143**, labeled "Camera;"
  - Icon **432** for online video module **155**, labeled "Online Video"
  - Icon **434** for stocks widget **149-2**, labeled "Stocks;"
  - Icon **436** for map module **154**, labeled "Map;"
  - Icon **438** for weather widget **149-1**, labeled "Weather;"
  - Icon **440** for alarm clock widget **149-4**, labeled "Clock;"
  - Icon **442** for workout support module **142**, labeled "Workout Support;"
  - Icon **444** for notes module **153**, labeled "Notes;" and
  - Icon **446** for a settings application or module, which provides access to settings for device **100** and its various applications **136**.

It should be noted that the icon labels illustrated in FIG. **4**A are merely exemplary. For example, icon **422** for video and music player module **152** are labeled "Music" or "Music Player." Other labels are, optionally, used for various application icons. In some embodiments, a label for a respective application icon includes a name of an application corresponding to the respective application icon. In some embodiments, a label for a particular application icon is distinct from a name of an application corresponding to the particular application icon.

FIG. **4**B illustrates an exemplary user interface on a device (e.g., device **300**, FIG. **3**) with a touch-sensitive surface **451** (e.g., a tablet or touchpad **355**, FIG. **3**) that is separate from the display **450** (e.g., touch screen display **112**). Device **300** also, optionally, includes one or more contact intensity sensors (e.g., one or more of sensors **357**) for detecting intensity of contacts on touch-sensitive surface **451** and/or one or more tactile output generators **359** for generating tactile outputs for a user of device **300**.

Although some of the examples which follow will be given with reference to inputs on touch screen display **112** (where the touch sensitive surface and the display are combined), in some embodiments, the device detects inputs on a touch-sensitive surface that is separate from the display, as shown in FIG. **4**B. In some embodiments the touch sensitive surface (e.g., **451** in FIG. **4**B) has a primary axis (e.g., **452** in FIG. **4**B) that corresponds to a primary axis (e.g., **453** in FIG. **4**B) on the display (e.g., **450**). In accordance with these embodiments, the device detects contacts (e.g., **460** and **462** in FIG. **4**B) with the touch-sensitive surface **451** at locations that correspond to respective locations on the display (e.g., in FIG. **4**B, **460** corresponds to **468** and **462** corresponds to **470**). In this way, user inputs (e.g., contacts **460** and **462**, and movements thereof) detected by the device on the touch-sensitive surface (e.g., **451** in FIG. **4**B) are used by the device to manipulate the user interface on the display (e.g., **450** in FIG. **4**B) of the multifunction device when the touch-sensitive surface is separate from the display. It should be understood that similar methods are, optionally, used for other user interfaces described herein.

Additionally, while the following examples are given primarily with reference to finger inputs (e.g., finger contacts, finger tap gestures, finger swipe gestures), it should be understood that, in some embodiments, one or more of the finger inputs are replaced with input from another input device (e.g., a mouse based input or stylus input). For example, a swipe gesture is, optionally, replaced with a mouse click (e.g., instead of a contact) followed by movement of the cursor along the path of the swipe (e.g., instead of movement of the contact). As another example, a tap gesture is, optionally, replaced with a mouse click while the cursor is located over the location of the tap gesture (e.g., instead of detection of the contact followed by ceasing to detect the contact). Similarly, when multiple user inputs are simultaneously detected, it should be understood that multiple computer mice are, optionally, used simultaneously, or a mouse and finger contacts are, optionally, used simultaneously.

As used herein, the term "focus selector" refers to an input element that indicates a current part of a user interface with which a user is interacting. In some implementations that include a cursor or other location marker, the cursor acts as a "focus selector," so that when an input (e.g., a press input) is detected on a touch-sensitive surface (e.g., touchpad **355** in FIG. **3** or touch-sensitive surface **451** in FIG. **4**B) while the cursor is over a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations that include a touch-screen display (e.g., touch-sensitive display system **112** in FIG. **1**A or touch screen **112** in FIG. **4**A) that enables direct interaction with user interface elements on the touch-screen display, a detected contact on the touch-screen acts as a "focus selector," so that when an input (e.g., a press input by the contact) is detected on the touch-screen display at a location of a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations focus is moved from one region of a user interface to another region of the user interface without corresponding movement of a cursor or movement of a contact on a touch-screen display (e.g., by using a tab key or arrow keys to move focus from one button to another button); in these implementations, the focus selector moves in accordance with movement of focus between different regions of the user interface. Without regard to the specific form taken by the focus selector, the focus selector is generally the user interface element (or contact on a touch-screen display) that is controlled by the user so as to communicate the user's intended interaction with the user interface (e.g., by indicating, to the device, the element of the user interface with which the user is intending to interact). For example, the location of a focus selector (e.g., a cursor, a contact or a selection box) over a respective button while a press input is detected on the touch-sensitive surface (e.g., a touchpad or touch screen) will indicate that the user is intending to activate the respective button (as opposed to other user interface elements shown on a display of the device).

The user interface figures described below include various intensity diagrams that show the current intensity of the contact on the touch-sensitive surface relative to one or more intensity thresholds (e.g., a contact detection intensity threshold IT_0, a light press intensity threshold IT_L, a deep press intensity threshold IT_D, and/or one or more other intensity thresholds). This intensity diagram is typically not part of the displayed user interface, but is provided to aid in the interpretation of the figures. In some embodiments, the light press intensity threshold corresponds to an intensity at which the device will perform operations typically associated with clicking a button of a physical mouse or a trackpad. In some embodiments, the deep press intensity threshold corresponds to an intensity at which the device will perform operations that are different from operations typically associated with clicking a button of a physical mouse or a trackpad. In some embodiments, when a contact is detected with an intensity below the light press intensity threshold (e.g., and above a nominal contact-detection intensity threshold IT_0 below which the contact is no longer detected), the device will move a focus selector in accordance with movement of the contact on the touch-sensitive surface without performing an operation associated with the light press intensity threshold or the deep press intensity threshold. Generally, unless otherwise stated, these intensity thresholds are consistent between different sets of user interface figures.

An increase of intensity of the contact from an intensity below the light press intensity threshold IT_L to an intensity between the light press intensity threshold IT_L and the deep press intensity threshold IT_D is sometimes referred to as a "light press" input. An increase of intensity of the contact from an intensity below the deep press intensity threshold IT_D to an intensity above the deep press intensity threshold IT_D is sometimes referred to as a "deep press" input. An increase of intensity of the contact from an intensity below the contact-detection intensity threshold IT_0 to an intensity between the contact-detection intensity threshold IT_0 and the light press intensity threshold IT_L is sometimes referred to as detecting the contact on the touch-surface. A decrease of intensity of the contact from an intensity above the contact-detection intensity threshold IT_0 to an intensity below the contact intensity threshold IT_0 is sometimes referred to as detecting liftoff of the contact from the touch-surface. In some embodiments IT_0 is zero. In some embodiments IT_0 is greater than zero. In some illustrations a shaded circle or oval is used to represent intensity of a contact on the touch-sensitive surface. In some illustrations a circle or oval without shading is used represent a respective contact on the touch-sensitive surface without specifying the intensity of the respective contact.

In some embodiments described herein, one or more operations are performed in response to detecting a gesture that includes a respective press input or in response to detecting the respective press input performed with a respective contact (or a plurality of contacts), where the respective press input is detected based at least in part on detecting an increase in intensity of the contact (or plurality of contacts) above a press-input intensity threshold. In some embodiments, the respective operation is performed in response to detecting the increase in intensity of the respective contact above the press-input intensity threshold (e.g., a "down stroke" of the respective press input). In some embodiments, the press input includes an increase in intensity of the respective contact above the press-input intensity threshold and a subsequent decrease in intensity of the contact below the press-input intensity threshold, and the respective operation is performed in response to detecting the subsequent decrease in intensity of the respective contact below the press-input threshold (e.g., an "up stroke" of the respective press input).

In some embodiments, the device employs intensity hysteresis to avoid accidental inputs sometimes termed "jitter," where the device defines or selects a hysteresis intensity threshold with a predefined relationship to the press-input intensity threshold (e.g., the hysteresis intensity threshold is X intensity units lower than the press-input intensity threshold or the hysteresis intensity threshold is 75%, 90% or some reasonable proportion of the press-input intensity threshold). Thus, in some embodiments, the press input includes an increase in intensity of the respective contact above the press-input intensity threshold and a subsequent decrease in intensity of the contact below the hysteresis intensity threshold that corresponds to the press-input intensity threshold, and the respective operation is performed in response to detecting the subsequent decrease in intensity of the respective contact below the hysteresis intensity threshold (e.g., an "up stroke" of the respective press input). Similarly, in some embodiments, the press input is detected only when the device detects an increase in intensity of the contact from an intensity at or below the hysteresis intensity threshold to an intensity at or above the press-input intensity threshold and, optionally, a subsequent decrease in intensity of the contact to an intensity at or below the hysteresis intensity, and the respective operation is performed in response to detecting the press input (e.g., the increase in intensity of the contact or the decrease in intensity of the contact, depending on the circumstances).

For ease of explanation, the description of operations performed in response to a press input associated with a press-input intensity threshold or in response to a gesture including the press input are, optionally, triggered in response to detecting either: an increase in intensity of a contact above the press-input intensity threshold, an increase in intensity of a contact from an intensity below the hysteresis intensity threshold to an intensity above the press-input intensity threshold, a decrease in intensity of the contact below the press-input intensity threshold, and/or a decrease in intensity of the contact below the hysteresis intensity threshold corresponding to the press-input intensity threshold. Additionally, in examples where an operation is described as being performed in response to detecting a decrease in intensity of a contact below the press-input intensity threshold, the operation is, optionally, performed in response to detecting a decrease in intensity of the contact below a hysteresis intensity threshold corresponding to, and lower than, the press-input intensity threshold.

User Interfaces and Associated Processes

Managing Activation of a Control Based on Contact Intensity

Many electronic devices have graphical user interfaces with controls which, upon activation, perform various operations at the device. However, some controls control more important functions than other controls and thus it would be helpful to provide users with feedback indicating whether or not the control controls an important function (e.g., buttons in a user interface that allow users to permanently delete user accounts, modify security settings on files or folders, change account passwords, and the like). For example, an electronic device can make a button or other control harder to activate by enforcing a time and/or intensity thresholds for buttons performing important options that are different from time and/or intensity thresholds for buttons for performing less important operations. In some situations, a device optionally requires a user to actively and deliberately confirm intent to delete a user account by enabling activation of an account deletion button only after the user has pressed on a touch-sensitive surface with an intensity above a predefined intensity threshold. However, these different thresholds for buttons associated with important operations may be confusing for a user, as the thresholds are different from thresholds used for other controls in the user interface. As such, in it would be advantageous to provide visual feedback to the user so as to indicate progress toward meeting the time and/or intensity thresholds for activating controls associated with important operation. However, there is a need for an additional layer of safeguard against accidental or inadvertent activation of such controls by users in a user interface, by providing adaptive, continuous, real-time, visual feedback to the user attempting to activate such controls—based on the user's input (e.g., based on an intensity or duration of the user's contact, for instance, on a touch-sensitive surface; the contact having time-varying intensity or pressure).

The disclosed embodiments provide a method, system, and user interface for managing activation of controls in a user interface (e.g., for managing activation of a button to permanently delete a user account, or to change security settings on an important file or folder, or to reset a password in a user account), by providing visual feedback to the user based on an intensity (e.g., pressure) and/or a duration of the user's contact. Such visual feedback is provided, for example, by changing the appearance of the control based on the intensity (e.g., pressure) and/or the duration of the user-contact or by displaying a visual confirmation (e.g., based on the intensity and/or the duration of the user contact) that the control will be activated upon termination of the user-contact. As a result, the disclosed embodiments help to ensure that the user does not accidentally activate such controls while providing visual feedback so that the user is informed of the additional intensity and/or time thresholds associated with activation of such controls. Such methods provide an added layer of security and safeguard to a user in order to prevent accidental or inadvertent activation of such controls by the user while providing additional feedback to the user so that the user is aware of the different intensity and/or time thresholds that are applied to the controls.

FIGS. **5**A-**5**M illustrate exemplary user interfaces for governing or managing activation of controls on a user interface based on the intensity (e.g., pressure) and/or duration of a contact, in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **6**A-**6**D. FIGS. **5**A-**5**K include intensity diagrams that show the current intensity of the contact on the touch-sensitive surface relative to a first intensity threshold ("IT_L") and a second threshold ("IT_D"), higher than the first intensity threshold. In some embodiments, operations similar to those described below with reference to IT_D are performed with reference to a different intensity threshold (e.g., "IT_L").

FIG. **5**A illustrates a user interface (e.g., a dialog box requesting a user for affirmation of user intent prior to performing a user-initiated action, such as a user-initiated request for an irreversible deletion of a file, a user account, or the like), with one or more controls (e.g., control buttons, such as control **14406** and control **14408**), that is displayed on display **450**.

FIGS. **5**A-**5**C illustrate providing the user a confirmation that a respective control (e.g., control **14408**, FIG. **5**A) will be activated—e.g., a user account will be irreversibly deleted—in response to a gesture (e.g., upon termination of the gesture), if the gesture includes a contact that meets predefined contact intensity criteria (e.g., if the contact has an intensity above a contact intensity threshold). FIGS. **5**A-**5**C also illustrate optionally activating the respective control (e.g., control **14408**, FIG. **5**A)—for example, deleting the user account—upon termination of the gesture if the gesture includes a contact that meets predefined contact intensity criteria (e.g., if the contact has an intensity above a contact intensity threshold, such as IT_D).

In FIG. **5**A, at time T0, no contact is present or detected on touch-sensitive surface **451**. A focus selector **14410** is at a location on display **450** corresponding to a respective control (e.g., control **14408**, FIG. **5**A). In FIG. **5**B, at time T1, a contact or a gesture that includes a contact (e.g., contact **14413** in FIG. **5**B) is detected on the touch-sensitive surface **451**. As shown in FIG. **5**B, while focus selector **14410** is at the location on display **450** corresponding to the respective control (e.g., control **14408**, FIG. **5**B), the contact (e.g., contact **14413** on the touch-sensitive surface **451**) meets predefined contact intensity criteria. In the example shown in FIG. **5**B, the predefined contact intensity criteria include a contact intensity threshold, such that if an intensity of contact **14413** exceeds the contact intensity threshold, then contact **14413** meets the predefined contact intensity criteria. In some embodiments, the predefined contact intensity criteria include a contact intensity threshold and a respective delay time period. In the example shown in FIG. **5**B, in such embodiments, if an intensity of contact **14413** exceeds the contact intensity threshold (e.g., "IT_D") for at least a delay time T_{delay}=T2−T1, then contact **14413** meets the predefined contact intensity criteria. As another example, referring to FIG. **5**B, when the predefined contact intensity criteria include a contact intensity threshold and a respective delay time period, the respective delay time period is a predefined time period (e.g., T_{delay}=T3−T1) since (e.g., after) the respective contact intensity threshold is met (e.g., time period starting at time T1, FIG. **5**B) in which contact **14413** must continue to be detected, even if the contact intensity is not maintained at or above the respective contact intensity threshold (e.g., "IT_D").

Continuing along the example illustrated in FIG. **5**B, since contact **14413** meets the predefined contact intensity criteria (e.g., an intensity of contact **14413** exceeds the contact intensity threshold), a confirmation is provided to the user indicating that control **14408** will be activated upon detecting the end of the gesture (e.g., upon detecting finger lift-off). In the example shown in FIG. **5**B, the confirmation is optionally shown as control **14408** completely filling up with a different color compared to a color of control **14408** prior to time T1 (e.g., prior to contact **14413** meeting the predefined contact intensity criteria, as shown in FIG. **5**A). Alternatively, or in addition, as shown in FIG. **5**B, the confirmation is provided to the user as verbal or textual confirmation **14412** indicating that control **14408** will be activated (e.g., the user account will be deleted) upon termination of the gesture.

In FIG. **5**C, at time T' subsequent to time T1, upon detecting termination of the gesture or termination of contact **14413** (e.g., upon detecting finger lift-off), control **14408** (FIG. **5**B) is activated (e.g., the user account is deleted).

If, on the other hand, the gesture does not include a contact that meets the predefined contact intensity criteria (for example, if contact **14413** does not have an intensity above the contact intensity threshold), then the control (e.g., control **14408**) is not activated in response to the gesture (e.g., in response to detecting termination of the gesture). Consequently, the user is not provided with a confirmation that the control will be activated in response to the gesture (e.g., upon termination of the gesture). Instead, in some embodiments, if the gesture does not include a contact **14413** that meets the predefined contact intensity criteria, the user would continue to view the user interface shown in FIGS. **5**A-**5**B unless the user chooses to cancel the deletion of the user account by activating control **14406**. In some embodiments, the user chooses to cancel the deletion of the user account by activating control by placing focus selector **14410** over "Cancel" button **14406** and increasing the intensity of contact **14413** above a lower contact intensity threshold (e.g., "IT_L") than the contact intensity threshold (e.g., "IT_D") at which "Delete" button **14408** is activated and then lifting the contact off of the touch-sensitive surface.

Thus, in some embodiments, the device determines if the gesture includes a contact that meets contact intensity criteria (e.g., if the intensity of the contact is above or greater than an intensity threshold) while the focus selector is at a location corresponding to a control on the display. If the contact meets the contact intensity criteria, the device provides the user with a confirmation that the contact will be activated upon detecting the end of the gesture. As a result, the user has the improved convenience of receiving real-time confirmation of user-intent (e.g., to activate the control) based on the user input (e.g., based on intensity and/or duration of user-contact). This additional confirmation provides the user a safeguard against accidental and inadvertent activation of the control by the user.

FIGS. **5**D-**5**H illustrate detecting a user gesture, corresponding to a control (e.g., control **14408**), on a touch-sensitive surface **451**; the gesture including a contact (e.g., having time-varying intensity or pressure detected by the touch-sensitive surface or sensors associated with the touch-sensitive surface). FIGS. **5**D-**5**H further illustrate providing the user a visual indication or feedback of progress toward the contact meeting predefined contact intensity criteria (e.g., providing a visual indication that the time-varying intensity of the contact is approaching or increasing toward meeting a predefined contact intensity threshold, for instance as the user pushes down harder on the touch-sensitive surface). FIGS. **5**D-**5**H additionally illustrate providing a confirmation to the user that the control (e.g., control **14408**, FIG. **5**D) will be activated—e.g., a user account will be irreversibly deleted—in response to the gesture (e.g., upon termination of the gesture) if the contact meets the predefined contact intensity criteria. FIGS. **5**D-**5**H illustrate subsequently activating the control (e.g., control **14408**)—for example, deleting the user account—upon termination of the gesture if the contact meets predefined contact intensity criteria.

In FIG. **5**D, at time T0, no contact is present or detected on touch-sensitive surface **451**. A focus selector **14410** is at a location on display **450** corresponding to a respective control (e.g., control **14408**, FIG. **5**D). In FIG. **5**E, at time T', a contact or a gesture that includes a contact (e.g., contact **14414** in FIG. **5**E) is detected on touch-sensitive surface **451**. As shown in FIG. **5**E, at time T', while focus selector **14410** is still at the location on display **450** corresponding to the respective control (e.g., control **14408**, FIG. **5**E), contact **14414** has an intensity I', lower than the contact intensity threshold (e.g., "IT_D") and, optionally above a different button activation intensity threshold (e.g., "IT_L"). In response to detecting a user contact of intensity I' (lower than the contact intensity threshold), the user is provided a visual indication of progress toward contact **14414** meeting the predefined contact intensity criteria. For example, as shown in FIG. **5**E, control **14408** changes appearance (compared to its appearance in FIG. **5**D), for instance as a progress bar is displayed in control **14408**. As another example, control **14408** changes appearance by displaying an indication of a difference (e.g., corresponding to a portion of control **14408** that is not filled in with gray) between a current intensity of contact **14414** (e.g., corresponding to the grayed or filled out portion of control **14408**) on touch-sensitive surface **451** and the contact intensity threshold.

Similarly, as shown in FIG. **5**F, at time T", while focus selector **14410** is still at the location on display **450** corresponding to the respective control (e.g., control **14408**, FIG. **5**F), contact **14414** has an intensity I", lower than the contact intensity threshold (e.g., "IT_D"). In response to detecting an intensity I" of contact **14414** (lower than the contact intensity threshold, but greater than the intensity I' of contact **14414** at time T' shown in FIG. **5**E), the user is provided a visual indication of progress toward contact **14414** meeting or approaching the predefined contact intensity criteria. As shown in FIG. **5**F, control **14408** further changes appearance (compared to its appearance in FIG. **5**D and subsequently in FIG. **5**E), for example as the progress bar displayed in control **14408** increases in size (relative to FIG. **5**E) in response to the increased intensity of contact **14414** (again, relative to FIG. **5**E) toward the contact intensity threshold. As another example, control **14408** further changes appearance by displaying an indication of the difference (e.g., corresponding to a portion of control **14408** that is not filled in with gray) between the current intensity (I") of contact **14414** (e.g., corresponding to the grayed or filled out portion of control **14408**) on touch-sensitive surface **451** and the contact intensity threshold. In some embodiments intensity I" is above a different button activation intensity threshold (e.g., "IT_L") for activating "Cancel" button **14406** (e.g., if the focus selector were over "Cancel" button **14406** in FIG. **5**F, "Cancel" button would have been activated).

As shown in FIG. **5**G, at time T1, while focus selector **14410** is still at the location on display **450** corresponding to the respective control (e.g., control **14408**, FIG. **5**G), contact **14414** on the touch-sensitive surface **451** meets predefined contact intensity criteria. In the example shown in FIG. **5**G, the predefined contact intensity criteria include a contact intensity threshold (e.g., "IT_D"). As a result, if and when the intensity of contact **14414** reaches or exceeds the contact intensity threshold, contact **14414** meets the predefined contact intensity criteria. Since contact **14414** meets the predefined contact intensity criteria at time T1, a confirmation is optionally provided to the user to indicate that control **14408** will be activated (e.g., the user account will be permanently deleted) upon detecting the end of the gesture (e.g., upon detecting lift-off of contact **14413**). In the example shown in FIG. **5**G, the confirmation is optionally shown as control **14408** completely filling up with a different color compared to a color of control **14408** prior to time T1 (e.g., prior to contact **14414** meeting the predefined contact intensity criteria), as shown in FIGS. **5**D-**5**F. Alternatively, or in addition, as shown in FIG. **5**G, the confirmation is provided to the user as verbal or textual confirmation **14412** indicating that control **14408** will be activated (e.g., the user account will be deleted) upon termination of the gesture.

As noted previously with reference to FIGS. **5**A-**5**C, in some embodiments, the predefined contact intensity criteria include a contact intensity threshold (e.g., "IT_D") and a respective delay time period. In the example shown in FIG. **5**G, in such embodiments, contact **14414** meets the predefined contact intensity criteria if the intensity of contact **14414** exceeds the contact intensity threshold for at least a delay time T_{delay}=T2−T1. In such embodiments, the progress bar displayed in control **14408** increases in size (e.g., starts to fill up) after the intensity of contact **14414** exceeds the contact intensity threshold, throughout the duration of the delay time. Conversely, in such embodiments, contact **14414** does not meet the predefined contact intensity criteria if the intensity of contact **14414** does not exceed the contact intensity threshold for at least a delay time T_{delay}=T2−T1. As another example, referring to FIG. **5**G, contact **14414** meets the predefined contact intensity criteria if contact **14414** continues to be detected for a predefined time period (e.g., T_{delay}=T3−T1) since (e.g., after) the intensity of contact **14414** exceeds the contact intensity threshold (e.g., time period starting at time T1, FIG. **5**G), even if the contact intensity is not maintained at or above the respective contact intensity threshold for the entire predefined time period.

In FIG. **5**H, at time T'" subsequent to time T1, upon detecting termination of the gesture or termination of contact **14414** (e.g., upon detecting lift-off of contact **14413**), control **14408** (FIGS. **5**D-**5**G) is activated (e.g., the user account is deleted) since the contact is determined to meet the predefined contact intensity criteria (e.g., in FIG. **5**G).

On the other hand, as noted with reference to FIGS. **5**A-**5**C, in some embodiments, if the gesture does not include a contact that meets the predefined contact intensity criteria (for example, if contact **14414** does not, at an end of the gesture, have an intensity above the contact intensity threshold), then the control (e.g., control **14408**) is not activated in response to the gesture (e.g., upon termination of the gesture). Consequently, the user is not provided with a confirmation that the control will be activated in response to the gesture (e.g., upon termination of the gesture). In some embodiments, the user is provided with a confirmation that the control will not be activated (e.g., by displaying "Delete" button **14408** that is not completely filled up with gray, as illustrated in FIG. **5**F). Instead, in some embodiments, if the gesture does not include a contact that meets the predefined contact intensity criteria, the user would continue to view a user interface similar to the user interface shown in FIGS. **5**D-**5**F (e.g., with the extent of visual indication provided in control corresponding to an instantaneous intensity level of the contact **14414**). In some embodiments, the user may optionally choose to cancel the deletion of the user account by activating control **14406**.

Thus, in some embodiments, the device determines if the gesture includes a contact that meets predefined contact intensity criteria (e.g., if the intensity of the contact is above or greater than an intensity threshold) while the focus selector is at a location corresponding to a control on the display. If the contact meets the contact intensity criteria, the device optionally provides the user with a confirmation that the contact will be activated upon detecting the end of the gesture. If the contact does not yet meet the contact intensity criteria, the device provides the user a visual indication of progress toward meeting the contact intensity based on a current state of user input (e.g., based on the time-varying intensity and/or duration of contact). As a result, the user has the improved convenience of receiving real-time indication of progress toward activation of the control based on the user's input (e.g., based on the time-varying intensity and/or duration of the user's contact), and, in response, the option to adjust the user's input (e.g., adjusting the pressure of the contact by pushing harder or more lightly) to affirm or reverse intent to activate the control. This additional visual indication and requirement for active user-affirmation provides the user with additional information that enables the user to understand how to activate a control that is protected by these extra safeguards against accidental activation of the control by the user.

FIGS. **5**I-**5**M illustrate detecting a user gesture corresponding to a control (e.g., control **14408**) on a touch-sensitive display **112**, the gesture including a contact (e.g., contact **14420**, having time-varying intensity or pressure detected by the touch-sensitive display **112** or sensors associated with the touch-sensitive display **112**). FIGS. **5**I-**5**M further illustrate providing the user a visual indication or feedback indicating progress toward the contact meeting predefined contact intensity criteria (e.g., providing a visual indication that the time-varying intensity of the contact is approaching or increasing toward a predefined contact intensity threshold (e.g., "IT_D"), for instance as the user pushes down harder on the touch-sensitive surface). FIGS. **5**I-**5**M additionally illustrate providing a confirmation to the user that a respective control (e.g., control **14408**, FIG. **5**I) will be activated—e.g., a user account will be irreversibly deleted—in response to the gesture (e.g., upon termination of the gesture) if the contact meets the predefined contact intensity criteria. FIGS. **5I-5M** also illustrate subsequently activating the control (e.g., control **14408**)—for example, deleting the user account—upon termination of the gesture if the contact meets predefined contact intensity criteria.

In FIG. **5I**, at time T0, no contact is present or detected on touch-sensitive display **112**. In FIG. **5J**, at time T', a contact or a gesture that includes a contact (e.g., contact **14420** in FIG. **5J**) is detected on touch-sensitive display **112**. A focus selector (corresponding to contact **14420**) is at a location on display **112** corresponding to a respective control (e.g., control **14408**, FIG. **5J**). As shown in FIG. **5J**, at time T', while focus selector **14410** is still at the location on touch-sensitive display **112** corresponding to the respective control (e.g., control **14408**, FIG. **5J**), contact **14420** has an intensity I', lower than the contact intensity threshold (e.g., "IT_D"). In response to detecting a user contact of intensity I' (lower than the contact intensity threshold), the user is provided a visual indication of progress toward contact **14420** meeting predefined contact intensity criteria. For example, as shown in FIG. **5J**, control **14408** changes appearance (compared to its appearance in FIG. **5I**), for instance as a progress bar is displayed in control **14408**. As another example, control **14408** changes appearance by displaying an indication of a difference (e.g., corresponding to a portion of control **14408** that is not filled in with gray) between a current intensity of contact **14420** (e.g., corresponding to the grayed or filled out portion of control **14408**) on touch-sensitive display **112** and the contact intensity threshold.

Similarly, as shown in FIG. **5K**, at time T", while focus selector **14410** is still at the location on touch-sensitive display **112** corresponding to the respective control (e.g., control **14408**, FIG. **5K**), contact **14420** has an intensity I", lower than the contact intensity threshold. In response to detecting an intensity I" of contact **14420** (lower than the contact intensity threshold (e.g., "IT_D"), but greater than the intensity I' of contact **14420** at time T' shown in FIG. **5J**), the user is provided a visual indication of progress toward contact **14420** meeting or approaching the predefined contact intensity criteria. As shown in FIG. **5K**, control **14408** further changes appearance (compared to its appearance in FIG. **5I** and subsequently in FIG. **5J**), for example as the progress bar displayed in control **14408** increases in size (relative to FIG. **5J**) in response to the increased intensity of contact **14420** (again, relative to FIG. **5J**) toward the contact intensity threshold.

As shown in FIG. **5L**, at time T1, while focus selector **14410** is still at the location on touch-sensitive display **112** corresponding to the respective control (e.g., control **14408**, FIG. **5L**), contact **14420** on the touch-sensitive display **112** meets predefined contact intensity criteria. In the example shown in FIG. **5L**, the predefined contact intensity criteria include a contact intensity threshold (e.g., "IT_D"). As a result, when the intensity of contact **14420** reaches or exceeds the contact intensity threshold, then contact **14420** meets the predefined contact intensity criteria. Since contact **14420** meets the predefined contact intensity criteria, a confirmation is optionally provided to the user to indicate that control **14408** will be activated (e.g., the user account will be permanently deleted) upon detecting the end of the gesture (e.g., upon detecting lift-off of contact **14420**). In the example shown in FIG. **5L**, the confirmation is optionally shown as control **14408** completely filling up with a different color compared to a color of control **14408** prior to time T1 (e.g., prior to contact **14420** meeting the predefined contact intensity criteria), as shown in FIGS. **5I-5K**. Alternatively, or in addition, as shown in FIG. **5L**, the confirmation is provided to the user as verbal or textual confirmation **14412** indicating that control **14408** will be activated (e.g., the user account will be deleted) upon termination of the gesture.

As noted previously with reference to FIGS. **5A-5C**, and with reference to FIGS. **5D-5H**, in some embodiments, the predefined contact intensity criteria include a contact intensity threshold (e.g., "IT_D") and a respective delay time period. In the example shown in FIG. **5L**, in such embodiments, contact **14420** meets the predefined contact intensity criteria if the intensity of contact **14420** exceeds the contact intensity threshold for at least a delay time T_{delay}=T2−T1. Conversely, in such embodiments, contact **14420** does not meet the predefined contact intensity criteria if the intensity of contact **14420** does not exceed the contact intensity threshold for at least a delay time T_{delay}=T2−T1. As another example, referring to FIG. **5L**, contact **14420** meets the predefined contact intensity criteria if the contact continues to be detected for a predefined time period (e.g., T_{delay}=T3−T1) since (e.g., after) the intensity of contact **14420** exceeds the contact intensity threshold (e.g., time period starting at time T1, FIG. **5L**), even if the contact intensity is not maintained at or above the respective contact intensity threshold for the entire predefined time period.

In FIG. **5M**, at time T'" subsequent to time T1, upon detecting termination of the gesture or termination of contact **14420** (e.g., upon detecting lift-off of contact **14420**), control **14408** (FIGS. **5I-5L**) is activated (e.g., the user account is deleted).

On the other hand, as noted with reference to FIGS. **5A-5C**, in some embodiments, if the gesture does not include a contact that meets the predefined contact intensity criteria (for example, if contact **14420** does not, at an end of the gesture, have an intensity above the contact intensity threshold), then the control (e.g., control **14408**) is not activated in response to the gesture (e.g., upon termination of the gesture). Consequently, the user is not provided with a confirmation that the control will be activated in response to the gesture (e.g., upon termination of the gesture). In some embodiments, the user is provided with a confirmation that the control will not be activated (e.g., by displaying "Delete" button **14408** that is not completely filled up with gray, as illustrated in FIG. **5K**). Instead, in some embodiments, if the gesture does not include a contact that meets the predefined contact intensity criteria, the user would continue to view a user interface similar to those shown in FIGS. **5I-5K** (e.g., with the extent of visual indication provided in control corresponding to an instantaneous intensity level of the contact **14420**). In some embodiments, the user may optionally choose to cancel the deletion of the user account by activating control **14406**.

FIGS. **6A-6D** are flow diagrams illustrating a method **14500** of governing or managing activation of controls based on the intensity of a contact in accordance with some embodiments. The method **14500** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1A**) with a display and a touch-sensitive surface. In some embodiments, the display is a touch screen display and the touch-sensitive surface is on the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **14500** are, optionally, combined and/or the order of some operations is, optionally, changed.

As described below, the method **14500** provides an intuitive way to manage activation of controls based on the intensity of a contact. The method reduces the cognitive burden on a user when managing activation of controls based on the intensity of a contact, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, enabling a user to manage activation of controls based on the intensity of a contact faster and more efficiently conserves power and increases the time between battery charges.

The device displays (**14502**), on a display, a respective control (e.g., a button or slider) associated with respective contact intensity criteria. For example, the respective control has a corresponding predefined contact intensity threshold (e.g., "IT_D") that needs to be met by a detected contact in order to activate the control. For example, as described with reference to FIGS. **5**A-**5**C, control **14408** (e.g., a control to delete a user account) displayed on display **450** is associated with a contact intensity threshold (e.g., "IT_D") that needs to be met by a contact detected on touch-sensitive surface **451** in order to activate control **14408**.

While a focus selector is (**14504**) at a location on the display that corresponds to the respective control: the device performs one or more of operations **14506**-**14534**.

The device detects (**14506**) a gesture, on a touch-sensitive surface, that corresponds to an interaction with the respective control. For example, as explained with reference to FIGS. **5**A-**5**C, while focus selector **14410** is at a location on display **450** corresponding to control **14408**, a gesture (e.g., including contact **14413**, FIG. **5**B) is detected on touch-sensitive surface **451**.

While detecting the gesture, the device determines (**14508**) whether the gesture includes a contact that meets the respective contact intensity criteria. In some embodiments, in accordance with a determination that the gesture includes (**14510**) a contact that meets the respective contact intensity criteria, the device provides (**14512**) a confirmation that the respective control will be activated upon detecting the end of the gesture. For example, as shown in FIG. **5**B, upon determining that intensity of contact **14413** is above the contact intensity threshold (e.g., "IT_D"), the device displays an updated appearance of the progress indicator, such as displaying the control (e.g., control **14408**, FIG. **5**B) filling completely up with a different color (e.g., control **14408**, with a white background, fills up with gray). As another example, as shown in FIG. **5**B, upon determining that intensity of contact **14413** is above the contact intensity threshold, the device displays a verbal or textual confirmation **14412** indicating that control **14408** will be activated (e.g., the user account will be deleted) upon termination of the gesture.

In accordance with a determination that the gesture does not (e.g., yet) (**14514**) include a contact that meets the respective contact intensity criteria, the device performs one or more of operations **14516**-**14562**.

In accordance with a determination that the gesture does not (e.g., yet) (**14514**) include a contact that meets the respective contact intensity criteria, the device changes (**14516**) the appearance of the respective control to indicate progress toward meeting the respective contact intensity criteria, as described with reference to operations **14518**-**14528**. For example, as explained with reference to FIGS. **5**D-**5**F above, upon determining that an intensity of contact **14414** (e.g., intensity I' at time T', and intensity I" at time T" corresponding to increasing contact pressure applied by the user) is lower than the contact intensity threshold, the device changes (**14516**) the appearance of control **14408** to indicate progress toward meeting the contact intensity threshold (e.g., as a progress bar is displayed in control **14408** or as control **14408** gradually fills up with a gray color).

In some embodiments, the respective contact intensity criteria include (**14518**) a respective contact intensity threshold (e.g., "IT_D") and a respective delay time period. For example, as explained with reference to FIG. **5**G, the respective delay time period is a predefined time period in which the contact intensity meets or exceeds the respective contact intensity threshold (e.g., T_{delay}=T2−T1, FIG. **5**G). Alternatively, as explained with reference to FIG. **5**G, the respective delay time period is a predefined time period since (after) the respective contact intensity threshold is met (e.g., since time T1) in which the contact continues to be detected, even if the contact intensity is not maintained at or above the respective contact intensity threshold (e.g., T_{delay}=T3−T1, FIG. **5**G). In some embodiments, changing the appearance of the control includes displaying an indication of an amount of time remaining before the respective delay time period has elapsed. In some embodiments, in response to detecting an end of the gesture, such as liftoff of the contact, if the gesture meets the respective contact intensity criteria, including the respective delay time period, the device performs an operation associated with the control (e.g., the device deletes the user account upon detecting lift-off of contact **14414**, as explained with reference to FIG. **5**H). In some embodiments, as soon as the gesture meets the respective contact intensity criteria, including the respective delay time period, the device performs an operation associated with the control, without waiting to detect an end of the gesture, such as liftoff of the contact (e.g., in response to detecting that the gesture includes a contact with an intensity above the respective contact intensity threshold).

In some embodiments, the respective contact intensity criteria include (**14520**) a respective contact intensity threshold (e.g., "IT_D"), optionally, without a corresponding delay time period. For example, as explained with reference to FIG. **5**G, when the intensity (e.g., pressure) of contact **14414** on touch-sensitive surface **451** reaches or exceeds the contact intensity threshold, then contact **14414** meets the predefined contact intensity criteria. In some embodiments, changing the appearance of the control includes displaying an indication of a difference between a current intensity of a contact on the touch-sensitive surface and the respective contact intensity threshold. For example, as explained with reference to FIGS. **5**D-**5**F, control **14408** further changes appearance by displaying an indication of the difference (e.g., corresponding to a portion of control **14408** that is not filled in with gray) between the current intensity (I") of contact **14414** (e.g., corresponding to the grayed or filled out portion of control **14408**) on touch-sensitive surface **451** and the contact intensity threshold. In some embodiments, the device displays an indication of an additional amount of intensity (e.g., pressure) that a user needs to apply in order to activate the control. For example, if the respective contact intensity threshold is 2X, and the detected intensity of the contact is X, then the "Delete" button would be filled up fifty percent of the way. In some embodiments, in response to detecting an end of the gesture, such as liftoff of the contact, if the gesture meets the respective contact intensity criteria, the device performs an operation associated with the control (e.g., the device deletes the user account upon detecting lift-off of contact **14414**, as explained with reference to FIG. **5**H). In some embodiments, as soon as the gesture meets the respective contact intensity criteria, the device performs an operation associated with the control, without waiting to detect an end of the gesture, such as liftoff of the contact.

In some embodiments, changing the appearance of the control includes (**14522**) displaying a progress bar in the control. For example, as explained with reference to FIGS.

5D-5H, control **14408** changes appearance (e.g., in FIG. 5E as compared to its appearance in FIG. 5D), for instance as a progress bar is displayed in control **14408** when the intensity of the contact changes.

In some embodiments, changing the appearance of the control includes (**14524**) changing color of at least a portion of the control in accordance with the intensity of the contact. For example, as explained with reference to FIGS. 5D-5H, control **14408** changes appearance (e.g., in FIG. 5E as compared to its appearance in FIG. 5D), as at least a portion of the control **14408** changes color (from white to gray) when the intensity of the contact changes.

In some embodiments, changing the appearance of the control includes (**14526**) changing color of at least a portion of the control in accordance with a length of time that the contact has continuously met a respective contact intensity threshold (e.g., "IT_D"). For example, the appearance of the control changes color with the time elapsed while the contact has continuously maintained an intensity at or above a predefined contact intensity. For example, if the respective time threshold is 2X (e.g., 1 second), and the detected time that the contact has maintained the respective contact intensity threshold is X (e.g., 0.5 seconds), then the "Delete" button would be filled up fifty percent of the way.

In some embodiments, changing the appearance of the control includes (**14528**) changing color of at least a portion of the control in accordance with a length of time since the contact met a respective contact intensity threshold (e.g., "IT_D"). For example, the appearance of the control changes with the time elapsed since the contact met a predefined contact intensity without regard to whether or not the contact has maintained the predefined contact intensity. For example, if the respective time threshold is 2X (e.g., 1 second), and the detected time that the contact has been detected since the contact reached the respective contact intensity threshold is X (e.g., 0.5 seconds), then the "Delete" button would be filled up fifty percent of the way.

In some embodiments, the device updates (**14530**) the appearance of the respective control over time to provide an updated indication of progress toward meeting the respective contact intensity criteria. For example, as explained with reference to FIGS. 5D-5G, control **14408** (e.g., a button) gradually fills up with (e.g., gray) color in accordance with a gradually increasing intensity of contact **14414** on touch-sensitive surface **451** (e.g., as the user pushes harder on touch-sensitive surface **451**). As another example, as explained with reference to FIGS. 5D-5G, control **14408** (e.g., a button) gradually fills with (e.g., gray) color as contact **14414** is maintained at an intensity above a respective contact intensity threshold (e.g., "IT_D") for a predefined period of time (e.g., T_{delay}=T2−T1, FIG. 5G) needed to activate the button (e.g., control **14408**).

In some embodiments, at a first time during the gesture, the gesture does not include (**14532**) a contact that meets the respective contact intensity criteria and the appearance of the respective control indicates that the control will not be activated in response to detecting an end of the gesture at the first time. In such embodiments, at a second time during the gesture, after the first time, the gesture includes (**14534**) a contact that meets the respective contact intensity criteria and the appearance of the respective control indicates that the control will be activated in response to detecting an end of the gesture at the second time. For example, the contact increases in intensity and/or duration during the gesture and thus at the end of the gesture, the control is activated. For example, as explained with reference to FIGS. 5D-5H, the intensity of contact **14414** increases from zero intensity (no contact, FIG. 5D) to intensity I' (FIG. 5E) to intensity I'' (FIG. 5F)—as the user pushes harder on touch-sensitive surface **451**—during which times contact **14414** does not meet contact intensity criteria. At these times, the appearance of control **14408** (e.g., control **14408** is not completely filled in gray color) indicates that control **14408** will not be activated (e.g., user account will not be deleted) in response to detecting an end of the gesture at these times. However, when the intensity of contact **14414** exceeds contact intensity threshold at time T1 (FIG. 5G), contact **14414** meets contact intensity criteria. At this time, the appearance of control **14408** (e.g., control **14408** is completely filled in with gray color) indicates that control **14408** will be activated (e.g., user account will be deleted) in response to detecting an end of the gesture at this time.

In some embodiments, after changing (**14536**) the appearance of the respective control: the device detects (**14538**) an end of the gesture. For example, as explained with reference to FIGS. 5D-5E, after changing the appearance of the respective control **14408**, the device detects liftoff of contact **14414** (FIG. 5E). In response to detecting the end of the gesture, the device determines (**14540**) whether the gesture includes a contact that meets the respective contact intensity criteria. In accordance with a determination that the gesture includes (**14542**) a contact that meets the respective contact intensity criteria, the device activates (**14544**) the control. For example, the device performs an operation associated with activation of the control (e.g., the device deletes the user account, as shown in FIG. 5H). In accordance with a determination that the gesture does not include (**14546**) a contact that meets the respective contact intensity criteria, the device forgoes (**14548**) activation of the control. For example, as explained with reference to FIGS. 5D-5H, upon determining that the gesture does not include a contact that meets the respective contact intensity criteria the device does not delete the user account, but rather returns the user to the user interface shown in FIG. 5D.

In some embodiments, after changing (**14550**) the appearance of the respective control: the device detects (**14552**) a respective contact with an intensity above a respective contact intensity threshold (e.g., "IT_D") for a detected time. In some embodiments, the respective contact is a contact of the gesture, such as a contact corresponds to a press input on the touch-sensitive surface while the focus selector is at the location on the display that corresponds to the respective control. In response to detecting the respective contact with the intensity above the respective contact intensity threshold for the detected time, the device determines (**14554**) whether the gesture includes a contact that meets the respective contact intensity criteria. In accordance with a determination that the gesture includes (**14556**) a contact that meets the respective contact intensity criteria, the device activates (**14558**) the control. For example, the device performs an operation associated with activation of the control without waiting to detect an end of the gesture (e.g., prior to lift off of the finger contact). In accordance with a determination that the gesture does not (**14560**) include a contact that meets the respective contact intensity criteria, the device forgoes (**14562**) activation of the control.

It should be understood that the particular order in which the operations in FIGS. 6A-6D have been described is merely exemplary and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments) are also applicable in an analogous manner to method **14500** described above with respect to FIGS. **6**A-**6**D. For example, the contacts, gestures, controls, user interface objects, intensity thresholds, focus selectors described above with reference to method **14500** optionally have one or more of the characteristics of the contacts, gestures, controls, user interface objects, intensity thresholds, focus selectors described herein with reference to other methods described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments). For brevity, these details are not repeated here.

In accordance with some embodiments, FIG. **7** shows a functional block diagram of an electronic device **14600** configured in accordance with the principles of the various described embodiments. The functional blocks of the device are, optionally, implemented by hardware, software, or a combination of hardware and software to carry out the principles of the various described embodiments. It is understood by persons of skill in the art that the functional blocks described in FIG. **7** are, optionally, combined or separated into sub-blocks to implement the principles of the various described embodiments. Therefore, the description herein optionally supports any possible combination or separation or further definition of the functional blocks described herein.

As shown in FIG. **7**, an electronic device **14600** includes a display unit **14602** configured to display on the display unit **14602**, a respective control associated with respective contact intensity criteria; a touch-sensitive surface unit **14604** configured to receive a contact on the touch-sensitive surface unit; one or more sensor units **14605** configured to detect intensity of contacts with the touch-sensitive surface unit **14604**; and a processing unit **14606** coupled to the display unit **14602**. In some embodiments, the processing unit **14606** includes a display enabling unit **14608**, a detecting unit **14610**, a changing unit **14612**, an activating unit **14614**, a providing unit **14618**, and an updating unit **14620**.

The processing unit **14606** is configured to: display, on the display unit **14602**, a respective control associated with respective contact intensity criteria; and while a focus selector is at a location on the display unit **14602** that corresponds to the respective control: detect a gesture, on the touch-sensitive surface unit **14604**, that corresponds to an interaction with the respective control (e.g., with the detecting unit **14610**); and while detecting the gesture, in accordance with a determination that the gesture does not include a contact that meets the respective contact intensity criteria, change the appearance of the respective control to indicate progress toward meeting the respective contact intensity criteria (e.g., with the changing unit **14612**).

In some embodiments, the processing unit **14606** is further configured to, after changing the appearance of the respective control: detect an end of the gesture (e.g., with the detecting unit **14610**); and in response to detecting the end of the gesture: in accordance with a determination that the gesture includes a contact that meets the respective contact intensity criteria, activate the control (e.g., with the activating unit **14614**); and in accordance with a determination that the gesture does not include a contact that meets the respective contact intensity criteria, forgo activation of the control (e.g., with the activating unit **14614**).

In some embodiments, the processing unit **14606** is further configured to, while detecting the gesture, in accordance with a determination that the gesture includes a contact that meets the respective contact intensity criteria, provide a confirmation that the respective control will be activated upon detecting the end of the gesture (e.g., with the providing unit **14618**).

In some embodiments, the processing unit **14606** is further configured to, after changing the appearance of the respective control: detect a respective contact with an intensity above a respective contact intensity threshold for a detected time (e.g., with the detecting unit **14610**); and in response to detecting the respective contact with the intensity above the respective contact intensity threshold for the detected time: in accordance with a determination that the gesture includes a contact that meets the respective contact intensity criteria, activate the control (e.g., with the activating unit **14614**); and in accordance with a determination that the gesture does not include a contact that meets the respective contact intensity criteria, forgo activation of the control (e.g., with the activating unit **14614**).

In some embodiments, at a first time during the gesture, the gesture does not include a contact that meets the respective contact intensity criteria and the appearance of the respective control indicates that the control will not be activated in response to detecting an end of the gesture at the first time; and at a second time during the gesture, after the first time, the gesture includes a contact that meets the respective contact intensity criteria and the appearance of the respective control indicates that the control will be activated in response to detecting an end of the gesture at the second time.

In some embodiments, the processing unit **14606** is further configured to update the appearance of the respective control over time to provide an updated indication of progress toward meeting the respective contact intensity criteria (e.g., with the updating unit **14620**).

In some embodiments, the respective contact intensity criteria include a respective contact intensity threshold and a respective delay time period; and changing the appearance of the control includes displaying an indication of an amount of time remaining before the respective delay time period has elapsed.

In some embodiments, the respective contact intensity criteria include a respective contact intensity threshold; and changing the appearance of the control includes displaying an indication of a difference between a current intensity of a contact on the touch-sensitive surface unit **14604** and the respective contact intensity threshold.

In some embodiments, changing the appearance of the control includes displaying a progress bar in the control (e.g., with the changing unit **14612**).

In some embodiments, changing the appearance of the control includes changing color of at least a portion of the control in accordance with the intensity of the contact (e.g., with the changing unit **14612**).

In some embodiments, changing the appearance of the control includes changing color of at least a portion of the control in accordance with a length of time that the contact has continuously met a respective contact intensity threshold (e.g., with the changing unit **14612**).

In some embodiments, changing the appearance of the control includes changing color of at least a portion of the control in accordance with a length of time since the contact met a respective contact intensity threshold (e.g., with the changing unit **14612**).

The operations in the information processing methods described above are, optionally implemented by running one or more functional modules in information processing apparatus such as general purpose processors (e.g., as described above with respect to FIGS. **1**A and **3**) or application specific chips.

The operations described above with reference to FIGS. **6**A-**6**D are, optionally, implemented by components depicted in FIGS. **1**A-**1**B or FIG. **7**. For example, displaying operation **14502**, detecting operation **14506**, and determining operation **14508** are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface corresponds to a predefined event or sub-event, such as selection of an object on a user interface. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally utilizes or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

Moving a Cursor According to a Change in an Appearance of a Control Icon with Simulated Three-Dimensional Characteristics

Many electronic devices display control icons (e.g., buttons) corresponding to content on a user interface that are responsive to a user input. A cursor is sometimes used to manipulate these controls in response to user input. However, when the input does not include a directional component, the cursor remains stationary while manipulating the controls. The embodiments provide a convenient and intuitive interface for activating controls by displaying a control icon with simulated three-dimensional characteristics on a user interface and detecting a stationary press input on a touch-sensitive surface that includes an increase in intensity of a contact that corresponds to a cursor displayed on the user interface over the control icon. Then, in response to detecting the stationary press input, the device changes an appearance of the simulated three-dimensional characteristics of the control icon (e.g., the control icon appears to move downward, or be depressed, along a simulated z-axis extending out of the plane of the display) and moves the cursor laterally on the display in accordance with the change in appearance of the control icon. In some embodiments, the cursor remains stationary relative to the control icon but moves relative to the background of the user interface as the control icon changes in appearance so as to provide the user with additional feedback indicating that the control icon is responding to changes in intensity of an input performed by the user (e.g., an intensity of a contact on a touch-sensitive surface that controls the cursor).

FIGS. **8**A-**8**K illustrate exemplary user interfaces for moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **9**A-**9**C. FIGS. **8**A-**8**K include intensity diagrams that show the current intensity of the contact on the touch-sensitive surface relative to a plurality of intensity thresholds including "IT_0," "IT_L" and "IT_D." In some implementations, an appearance of the respective control icon changes in accordance with the simulated three-dimensional characteristics of the respective control icon and in response to detecting a stationary press input that includes an increase in intensity of a contact (that corresponds to a displayed cursor) on the touch-sensitive surface in excess of one or more of a contact detection intensity threshold, "IT_0," a light press intensity threshold, "IT_L," and a deep press intensity threshold, "IT_D."

In some embodiments, the device is an electronic device with a separate display (e.g., display **450**) and a separate touch-sensitive surface (e.g., touch-sensitive surface **451**). In some embodiments, the device is portable multifunction device **100**, the display is touch-sensitive display system **112**, and the touch-sensitive surface includes tactile output generators **167** on the display (FIG. **1**A). For convenience of explanation, the embodiments described with reference to FIGS. **8**A-**8**K and FIGS. **9**A-**9**C will be discussed with reference to display **450** and a separate touch-sensitive surface **451**; however, analogous operations are, optionally, performed on a device with a touch-sensitive display system **112** in response to detecting the contacts described in FIGS. **8**A-**8**K on the touch-sensitive display system **112** while displaying the user interfaces shown in FIGS. **8**A-**8**K on the touch-sensitive display system **112**; in such embodiments, the focus selector is, optionally: a respective contact, a representative point corresponding to a contact (e.g., a centroid of a respective contact or a point associated with a respective contact), or a centroid of two or more contacts detected on the touch-sensitive display system **112**, in place of cursor **15604**.

FIG. **8**A illustrates respective control icon **15602** displayed at position **15602**-*a* on display **450**. FIG. **8**A further illustrates contact **15606** detected on touch-sensitive surface **451** at position **15606**-*a* and a displayed representation of a focus selector (e.g., cursor **15604**) at position **15604**-*a* on display **450** corresponding to contact **15604**. In this example, cursor **15604** is displayed at size S1, and subsequent position **15606**-*b* of contact **15606** is represented as a dotted circle on touch-sensitive surface **451**.

FIGS. **8**A-**8**B illustrate detecting movement of contact **15606** on touch-sensitive surface **451** (e.g., contact **15606** moves from position **15606**-*a* in FIG. **8**A to position **15606**-*b* in FIG. **8**B). In this example, cursor **15604** moves from position **15604**-*a* in FIG. **8**A to position **15604**-*b* in FIG. **8**B in response to detecting movement of contact **15606** on touch-sensitive surface **451**. FIG. **8**B illustrates cursor **15604** displayed at position **15604**-*b* over control icon **15602** on display **450**.

FIGS. **8**B-**8**C illustrate detecting, on touch-sensitive surface **451**, a stationary press input that includes an increase in intensity of contact **15606** that corresponds to cursor **15604**. In this example, contact **15606** remains stationary at position **15606**-*b* and the intensity of contact **15606** increases (e.g., from below IT_L in FIG. **8**B to above IT_L in FIG. **8**C).

FIGS. **8**B-**8**C further illustrate changing an appearance of respective control icon **15602** in accordance with the simulated three-dimensional characteristics of respective control icon **15602** (e.g., control icon **15602** appears to move downward along a simulated z-axis extending out of the plane of display **450** by moving from position **15602**-*a* in FIG. **8**B to position **15602**-*b* in FIG. **8**C). In this example, the amount of change in appearance of respective control icon **15602** is determined based on the intensity of contact **15606** on touch-sensitive surface **451** (e.g., control icon **15602** appears to be depressed further as the intensity of contact **15606** increases between FIGS. **8**B-**8**C). FIGS.

8B-8C further illustrate moving cursor **15604** laterally on display **450** (e.g., cursor **15604** moves from position **15604**-*b* in FIG. **8**B to position **15604**-*c* in FIG. **8**C) in accordance with the change in appearance of respective control icon **15602** (e.g., cursor **15604** moves as control icon **15602** appears to move downward along the simulated z-axis extending out of the plane of display **450** between FIGS. **8**B-**8**C).

FIGS. **8**B-**8**D illustrate cursor **15604** remaining stationary relative to respective control icon **15602** but moving laterally relative to the background (e.g., cursor **15604** moves from position **15604**-*b* in FIG. **8**B to position **15604**-*c* in FIG. **8**C, then to position **15604**-*d* in FIG. **8**D). FIGS. **8**B-**8**D further illustrate reducing a size of cursor **15604** (e.g., the size of cursor **15604** reduces from S1 in FIG. **8**B to S2 in FIG. **8**C, then to S3 in FIG. **8**D) in response to detecting the stationary press input (e.g., contact **15606** remains at position **15606**-*b* between FIGS. **8**B-**8**D) and in accordance with the increase in intensity of contact **15606** (e.g., the size of cursor **15604** reduces as the intensity of contact **15606** increases from below IT_L in FIG. **8**B to above IT_L in FIG. **8**D).

FIGS. **8**B-**8**D and **8**G illustrate moving respective control icon **15602** laterally on the display **450** to simulate downward motion of control icon **15602** when viewed at an angle (e.g., control icon **15602** is depressed from a maximum height at position **15602**-*a* in FIG. **8**B through intermediate heights at positions **15602**-*b* and **15602**-*c* in FIGS. **8**C and **8**D, respectively, to a minimum height at position **15602**-*d* in FIG. **8**G).

FIGS. **8**C-**8**E illustrate detecting, on touch-sensitive surface **451**, a decrease in intensity of contact **15606** that corresponds to cursor **15604** (e.g., the intensity of contact **15606** decreases between FIGS. **8**D-**8**E) after detecting the increase in intensity of contact **15606** that corresponds to cursor **15604** (e.g., after detecting the increase in intensity of contact **15606** between FIGS. **8**C-**8**D).

FIGS. **8**D-**8**F illustrate increasing a size of cursor **15604** (e.g., the size of cursor **15604** increases from S3 in FIG. **8**D to S2 in FIG. **8**E, then to S1 in FIG. **8**F) in response to detecting the decrease in intensity of contact **15606** (e.g., between FIGS. **8**D-**8**E) and in accordance with the decrease in intensity of contact **15606** (e.g., the size of cursor **15604** increases as the intensity of contact **15606** decreases between FIGS. **8**D-**8**F).

FIGS. **8**E-**8**F illustrate changing the appearance of respective control icon **15602** in accordance with the simulated three-dimensional characteristics of respective control **15602** icon (e.g., control icon **15602** appears to move upward along the simulated z-axis extending out of the plane of display **450** by moving from position **15602**-*c* in FIG. **8**D to position **15602**-*b* in FIG. **8**E, then to position **15602**-*a* in FIG. **8**F) in response to detecting the decrease in intensity of contact **15606** (e.g., between FIGS. **8**D-**8**E). FIGS. **8**E-**8**F further illustrate moving cursor **15604** laterally on display **450** (e.g., cursor **15604** moves from position **15604**-*d* in FIG. **8**D to position **15604**-*c* in FIG. **8**E, then to position **15604**-*b* in FIG. **8**F) in a direction that is substantially opposite to a direction in which cursor **15604** was moved in response to detecting the increase in intensity of the contact that corresponds to the cursor (e.g., cursor **15604** previously moved from position **15604**-*c* in FIG. **8**C to position **15604**-*d* in FIG. **8**D), in response to detecting the decrease in intensity of contact **15606** (e.g., between FIGS. **8**D-**8**E) and in accordance with the change in appearance of respective control icon **15602** (e.g., cursor **15604** moves as control icon **15602** moves upward along the simulated z-axis extending out of the plane of display **450**).

FIGS. **8**H-**8**K illustrate displaying a plurality of control icons (e.g., control icons **15608** and **15610**) with different simulated three-dimensional characteristics (e.g., different heights, or levels of protrusion, relative to a z-axis extending out of the plane of display **450**).

FIGS. **8**H-**8**I illustrate performing a first movement of cursor **15604** (e.g., cursor **15604** moves from position **15604**-*f* in FIG. **8**H to position **15604**-*g* in FIG. **8**I) in response to detecting the stationary press input (e.g., contact **15612** is stationary as the intensity of contact **15612** increases between FIGS. **8**H-**8**I) over respective control icon **15608** and in accordance with a determination that the respective control icon is first control icon **15608** with a first simulated three-dimensional characteristic (e.g., a height in excess of control icon **15610**). FIGS. **8**H-**8**I further illustrate reducing the size of cursor **15604** (e.g., the size of cursor **15604** reduces from S1 in FIG. **8**H to S4 in FIG. **8**I) in accordance with the increase in intensity of contact **15612** (e.g., the size of cursor **15604** reduces as the intensity of contact **15612** increases between FIGS. **8**H-**8**I).

FIGS. **8**J-**8**K illustrate performing a second movement of cursor **15604** (e.g., cursor **15604** moves from position **15604**-*h* in FIG. **8**J to position **15604**-*i* in FIG. **8**K), different from the first movement of the cursor (e.g., the movement of cursor **15604** between FIGS. **8**H-**8**I), in response to detecting the stationary press input (e.g., contact **15614** is stationary as the intensity of contact **15614** increases between FIGS. **8**J-**8**K) over respective control icon **15610** and in accordance with a determination that the respective control icon is second control icon **15610** with a second simulated three-dimensional characteristic (e.g., a height, which is less than control icon **15608**), different from the first simulated three-dimensional characteristic. FIGS. **8**J-**8**K further illustrate reducing the size of cursor **15604** (e.g., the size of cursor **15604** reduces from S1 in FIG. **8**J to S2 in FIG. **8**K) in accordance with the increase in intensity of contact **15614** (e.g., the size of cursor **15604** reduces as the intensity of contact **15614** increases between FIGS. **8**J-**8**K).

As shown in FIGS. **8**H-**8**K, the distance between position **15604**-*f* and **15604**-*g* is greater than the distance between positions **15604**-*h* and **15604**-*i* (e.g., because control **15608** has a greater simulated height than the simulated height of control **15610** in the z-direction of the user interface). In some circumstances, the press inputs in FIGS. **8**H-**8**I and **8**J-**8**K both include increasing contact **15604** from an intensity below IT_L to an intensity above IT_D. In some embodiments, in response to detecting either of the press inputs in FIGS. **8**H-**8**I or **8**J-**8**K, the device changes a size of cursor **15604** between a first size and a second size (e.g., the size of cursor **15604** depends on an intensity of a contact associated with the cursor, while the lateral movement of cursor **15604** depends on a simulated height of a control that is being "pressed" in response to the increase in intensity of the contact).

FIGS. **9**A-**9**C are flow diagrams illustrating a method **15700** of moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics in accordance with some embodiments. The method **15700** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1**A) with a display and a touch-sensitive surface. In some embodiments, the display is a touch screen display and the touch-sensitive surface is on the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **15700** are, optionally, combined and/or the order of some operations is, optionally, changed.

As described below, the method **15700** provides an intuitive way to move a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics. The method reduces the cognitive burden on a user when moving a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, enabling a user to move a cursor according to a change in an appearance of a control icon with simulated three-dimensional characteristics faster and more efficiently conserves power and increases the time between battery charges.

The device displays (**15702**), on a display, a respective control icon (e.g., a virtual button) with simulated three-dimensional characteristics (e.g., a three dimensional shape, drop shadow, etc.). FIG. **8**B, for example, shows a respective control icon (e.g., control icon **15602**) with simulated three-dimensional characteristics displayed on display **450** (e.g., a height relative to a z-axis extending out of a plane of display **450**). The device also displays (**15704**), on the display, a cursor over (or proximate to) the respective control icon. FIG. **8**B, for example, further shows cursor **15604** displayed on display **450** at position **15604**-*b* over control icon **15602**.

In some embodiments, prior to detecting a stationary press input, the device detects (**15706**) a movement of a contact on a touch-sensitive surface, and in response to detecting movement of the contact on the touch-sensitive surface, the device moves the cursor in accordance with the movement of the contact. FIGS. **8**A-**8**B, for example, show the device detecting a movement of contact **15606** from position **15606**-*a* in FIG. **8**A to position **15606**-*b* in FIG. **8**B on touch-sensitive surface **451** prior to detecting a stationary press input of contact **15606** (e.g., between FIGS. **8**B-**8**C). FIGS. **8**A-**8**B, for example, further show the device moving cursor **15604** from position **15604**-*a* in FIG. **8**A to position **15604**-*b* in FIG. **8**B on display **450** in accordance with the movement of contact **15606** on touch-sensitive surface **451** (e.g., cursor **15604**'s movement corresponds to movement of contact **15606** from position **15606**-*a* in FIG. **8**A to position **15606**-*b* in FIG. **8**B) and in response to detecting the movement of contact **15606**.

The device detects (**15708**), on the touch-sensitive surface, the stationary press input that includes an increase in intensity of a contact that corresponds to the cursor. FIGS. **8**B-**8**C, for example, show detecting the stationary press input (e.g., contact **15606** remains at position **15606**-*b* between FIGS. **8**B-**8**C) that includes an increase in intensity of contact **15606** on touch-sensitive surface **451** (e.g., the intensity of contact **15606** increases from below IT_L in FIG. **8**B to above IT_L in FIG. **8**C). In this example, contact **15606** on touch-sensitive surface **451** corresponds to displayed cursor **15604** on display **450**.

In response to detecting (**15710**) the stationary press input, the device changes (**15712**) an appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon (e.g., so that the control icon appears to move downward along the simulated z-axis extending out of the plane of the display). In some embodiments, the simulated z-axis of the display is at an angle with respect to the plane of the display, so that an x-y plane has a vanishing point on the display. FIGS. **8**B-**8**C, for example, show the device changing an appearance of control icon **15602** in accordance with its simulated three-dimensional characteristics (e.g., control icon **15602** appears to depress relative to the simulated z-axis extending out of the plane of the display **450**) in response to detecting the stationary press input (e.g., contact **15606** remains at position **15606**-*b* as the intensity of contact **15606** increases between FIGS. **8**B-**8**C).

In some embodiments, the amount of change in appearance of the respective control icon is determined (**15714**) based on the intensity of the contact on the touch-sensitive surface (e.g., as the contact increases in intensity, the cursor moves laterally in accordance with the intensity or change in intensity of the contact). FIGS. **8**B-**8**D, for example, show the amount of change in appearance of control icon **15602** determined based on the intensity of contact **15606** on touch-sensitive surface **451** (e.g., control icon **15602** depresses from position **15602**-*a* in FIG. **8**B to position **15602**-*b* in FIG. **8**C as the intensity of contact **15606** increases between FIGS. **8**B-**8**C and control icon **15602** depresses from position **15602**-*a* in FIG. **8**B to position **15602**-*c* in FIG. **8**D as the intensity of contact **15606** increases between FIGS. **8**B-**8**D).

In some embodiments, the respective control icon moves (**15716**) laterally on the display to simulate downward motion of a button when viewed at an angle (e.g., the virtual button moves "into" a hole in the display along a z-axis, where the z-axis is at an angle other than 90 degrees with respect to the plane of the display). FIGS. **8**B-**8**C, for example, show control icon **15602** moving laterally on display **450** to simulate downward motion of control icon **15602** when viewed at an angle (e.g., control icon **15602** appears to move downward along the simulated z-axis extending out of the plane of the display **450** from position **15602**-*a* in FIG. **8**B to position **15602**-*b* in FIG. **8**C).

In response to detecting (**15710**) the stationary press input, the device moves (**15718**) the cursor laterally on the display in accordance with the change in appearance of the respective control icon. FIGS. **8**B-**8**C, for example, show cursor **15604** moving laterally on display **450** (e.g., cursor **15604** moves from position **15604**-*b* in FIG. **8**B to position **15604**-*c* in FIG. **8**C) in accordance with the change in appearance of control icon **15602** (e.g., cursor **15604** moves as control icon **15602** depresses from position **15602**-*a* in FIG. **8**B to position **15602**-*b* in FIG. **8**C) and in response to detecting the stationary press input (e.g., contact **15606** remains at position **15606**-*b* as the intensity of contact **15606** increases between FIGS. **8**B-**8**C).

In some embodiments, the amount of lateral movement of the cursor on the display is determined (**15720**) based on an amount of change in appearance of the respective control icon on the display (e.g., as a virtual button is pushed "down" on the display, the cursor moves laterally in accordance with how far down the virtual button has been pushed). FIGS. **8**B-**8**C, for example, show an amount of lateral movement of cursor **15604** on display **450** (e.g., cursor **15604** moves from position **15604**-*b* in FIG. **8**B to position **15604**-*c* in FIG. **8**C) determined based on the amount of change in appearance of control icon **15602** on display **450** (e.g., cursor **15604** moves as control icon **15602** appears to depress, or be pushed "down," relative to the simulated z-axis extending out of the plane of the display **450** between FIG. **8**B-**8**C).

In some embodiments, the cursor is (**15722**) stationary relative to the respective control icon, and the cursor moves laterally relative to a background. FIGS. **8**B-**8**C, for example, show cursor **15604** displayed stationary relative to control icon **15602**, but cursor **15604** moves laterally from position **15604**-*b* in FIG. **8**B to position **15604**-*c* in FIG. **8**C relative to the background of display **450**.

In some embodiments, the device reduces (**15724**) a size of the cursor in accordance with the increase in intensity of the contact. FIGS. **8**B-**8**C, for example, show the device reducing the size of cursor **15604** (e.g., from S1 in FIG. **8**B to S2 in FIG. **8**C) in accordance with the increase in intensity of contact **15606** on touch sensitive surface **451** (e.g., the size of cursor **15604** reduces as the intensity of contact **15604** increases from below IT_L in FIG. **8**B to above IT_L in FIG. **8**C).

In some embodiments, after detecting (**15726**) the increase in intensity of the contact that corresponds to the cursor, the device detects (**15728**), on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor (e.g., while continuing to detect the contact on the touch-sensitive surface). FIGS. **8**C-**8**E, for example, show the device detecting a decrease in intensity of contact **15606** on touch-sensitive surface **451** (e.g., the intensity of contact **15606** decreases between FIGS. **8**D-**8**E) that corresponds to the cursor **15604** after the device detected the increase in intensity of contact **15606** (e.g., the intensity of contact **15606** increased between FIGS. **8**C-**8**D) that corresponds to cursor **15604**.

In some embodiments, in response to detecting the decrease in intensity of the contact, the device increases (**15730**) a size of the cursor in accordance with the decrease in intensity of the contact. FIGS. **8**D-**8**E, for example, show the device increasing the size of cursor **15604** (e.g., from S3 in FIG. **8**D to S2 in FIG. **8**E) in accordance with the decrease in intensity of contact **15606** (e.g., the size of cursor **15604** increases as the intensity of contact **15606** decreases between FIGS. **8**D-**8**F) and in response to detecting the decrease in intensity of the contact between FIGS. **8**D-**8**E.

In some embodiments, in response to detecting the decrease in intensity of the contact, the device changes (**15732**) the appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon (e.g., so that the control icon appears to move upward along a simulated z-axis out of the display), and the device moves the cursor laterally on the display in accordance with the change in appearance of the respective control icon in a direction that is substantially opposite to a direction in which the cursor was moved in response to detecting the increase in intensity of the contact that corresponds to the cursor. For example, if the cursor moves down and to the left in response to the increase in intensity of the contact during stationary press input, the cursor will move up and to the right in response to detecting a decrease in intensity of the contact.

FIGS. **8**D-**8**E, for example, show the device changing the appearance of control icon **15602** in accordance with its simulated three-dimensional characteristics (e.g., control icon **15602** appears to move upward along the simulated z-axis extending out of the plane of the display **450** as control icon **15602** moves from position **15602**-*c* in FIG. **8**D to position **15602**-*b* in FIG. **8**E) and in response to detecting the decrease in intensity of contact **15606**. FIGS. **8**D-**8**E, for example, further show the device moving cursor **15604** laterally on display **450** (e.g., cursor **15604** moves from position **15604**-*d* in FIG. **8**D to position **15604**-*c* in FIG. **8**E) in a direction that is substantially opposite to a direction in which cursor **15604** was moved in response to detecting the increase in intensity of contact **15606** that corresponds to cursor **15604** (e.g., cursor **15604** previously moved from position **15604**-*c* in FIG. **8**C to position **15604**-*d* in FIG. **8**D), in accordance with the change in appearance of the respective control icon (e.g., cursor **15604** moves as control icon **15602** appears to move upward along the simulated z-axis extending out of the plane of the display **450**) and in response to detecting the decrease in intensity of contact **15606**.

In some embodiments, the device displays (**15734**) a plurality of control icons with different simulated three-dimensional characteristics (e.g., different "heights" or angles with respect to the z-axis). FIG. **8**H, for example, shows the plurality of controls icons (e.g., control icons **15608** and **15610**) displayed on display **450** with different simulated three-dimensional characteristics (e.g., the height of control icon **15608** is in excess of the height of control icon **15610**).

In some embodiments, in accordance with a determination that the respective control icon is a first control icon with a first simulated three-dimensional characteristic, the device performs (**15736**) a first movement of the cursor in response to detecting the stationary press input. FIGS. **8**H-**8**I, for example, show the device performing a first movement of cursor **15604** (e.g., cursor **15604** moves from position **15604**-*f* in FIG. **8**H to position **15604**-*g* in FIG. **8**I) in accordance with a determination that the respective control icon is first control icon **15608** with the first simulated three-dimensional characteristic (e.g., the height of control icon **15608** is in excess of the height of control icon **15610**) and in response to detecting the stationary press input (e.g., contact **15612** is stationary as the intensity of contact **15612** increases between FIGS. **8**H-**8**I) over respective control icon **15608**.

In some embodiments, in accordance with a determination that the respective control icon is a second control icon with a second simulated three-dimensional characteristic, different from the first simulated three-dimensional characteristic, the device performs (**15738**) a second movement of the cursor, different from the first movement of the cursor, in response to detecting the stationary press input (e.g., the first movement and the second movement have a different direction and/or magnitude). For example, if the first button is simulated as being taller than the second button, then the cursor will move farther laterally in response to pressing down the first button down than in response to pressing down the second button. FIGS. **8**J-**8**K, for example, show the device performing a second movement of cursor **15604** (e.g., cursor **15604** moves from position **15604**-*h* in FIG. **8**J to position **15604**-*i* in FIG. **8**K) in accordance with a determination that the respective control icon is second control icon **15610** with the second simulated three-dimensional characteristic (e.g., the height of control icon **15610** is less than the height of control icon **15608**), different from the first simulated three-dimensional characteristic, and in response to detecting the stationary press input (e.g., contact **15614** is stationary as the intensity of contact **15614** increases between FIGS. **8**J-**8**K) over respective control icon **15610**.

It should be understood that the particular order in which the operations in FIGS. **9**A-**9**C have been described is merely exemplary and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., those listed in the thirty-first paragraph of the Description of Embodiments) are also applicable in an analogous manner to method **15700** described above with respect to FIGS. **9**A-**9**C. For example, the contacts, intensity thresholds, and focus selectors described above with reference to method **15700** optionally have one or more of the characteristics of the contacts, intensity thresholds, and focus selectors described herein with reference to other methods described herein (e.g., those listed in the thirty-first paragraph of the Description of Embodiments). For brevity, these details are not repeated here.

In accordance with some embodiments, FIG. **10** shows a functional block diagram of an electronic device **15800** configured in accordance with the principles of the various described embodiments. The functional blocks of the device are, optionally, implemented by hardware, software, or a combination of hardware and software to carry out the principles of the various described embodiments. It is understood by persons of skill in the art that the functional blocks described in FIG. **10** are, optionally, combined or separated into sub-blocks to implement the principles of the various described embodiments. Therefore, the description herein supports any possible combination or separation or further definition of the functional blocks described herein.

As shown in FIG. **10**, an electronic device **15800** includes: a display unit **15802** configured to display a respective control icon with simulated three-dimensional characteristics and a cursor over the respective control icon; a touch-sensitive surface unit **15804** configured to receive contacts; one or more sensor units **15806** configured to detect intensity of contacts with the touch-sensitive surface unit **15804**; and a processing unit **15808** coupled to the display unit **15802**, the touch-sensitive surface unit **15804** and the one or more sensor units **15806**. In some embodiments, the processing unit **15808** includes a detecting unit **15810**, a changing unit **15812**, a moving unit **15814**, a reducing unit **15816**, an increasing unit **15818**, a display enabling unit **15820**, and a determining unit **15822**. In some embodiments, a display control unit replaces and is configured to perform the operations of the changing unit **15812**, the moving unit **15814**, the reducing unit **15816**, the increasing unit **15818** and the display enabling unit **15820**.

The processing unit **15808** is configured to detect (e.g., with the detecting unit **15810**), on the touch-sensitive surface unit **15804**, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor. In response to detecting the stationary press input, the processing unit **15808** is further configured to: change (e.g., with the changing unit **15812**) an appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon; and move (e.g., with moving unit **15814**) the cursor laterally on the display unit **15802** in accordance with the change in appearance of the respective control icon.

In some embodiments, the respective control icon moves (e.g., with moving unit **15814**) laterally on the display unit **15802** to simulate downward motion of a button when viewed at an angle.

In some embodiments, the cursor is stationary relative to the respective control icon, and the cursor moves (e.g., with moving unit **15814**) laterally relative to a background.

In some embodiments, the processing unit **15808** is configured to reduce (e.g., with the reducing unit **15816**) a size of the cursor in accordance with the increase in intensity of the contact, in response to detecting the stationary press input.

In some embodiments, the processing unit **15808** is further configured to: detect (e.g., with the detecting unit **15810**), on the touch-sensitive surface unit **15804**, a decrease in intensity of the contact that corresponds to the cursor after detecting the increase in intensity of the contact that corresponds to the cursor; and in response to detecting the decrease in intensity of the contact, increase (e.g., with the increasing unit **15818**) a size of the cursor in accordance with the decrease in intensity of the contact.

In some embodiments, the processing unit **15808** is further configured to detect (e.g., with the detecting unit **15810**), on the touch-sensitive surface unit **15804**, a decrease in intensity of the contact that corresponds to the cursor after detecting the increase in intensity of the contact that corresponds to the cursor. In response to detecting the decrease in intensity of the contact the processing unit **15808** is configured to: change (e.g., with the changing unit **15812**) the appearance of the respective control icon in accordance with the simulated three-dimensional characteristics of the respective control icon; and move (e.g., with the moving unit **15814**) the cursor laterally on the display unit **15802** in accordance with the change in appearance of the respective control icon in a direction that is substantially opposite to a direction in which the cursor was moved in response to detecting the increase in intensity of the contact that corresponds to the cursor.

In some embodiments, the processing unit **15808** is further configured to: detect (e.g., with the detecting unit **15810**) movement of the contact on the touch-sensitive surface unit **15804** prior to detecting the stationary press input; and move (e.g., with the moving unit **15814**) the cursor in accordance with the movement of the contact, in response to detecting the movement of the contact on the touch-sensitive surface unit **15804**, prior to detecting the stationary press input.

In some embodiments, the processing unit **15808** is configured to: enable display of (e.g., with the display enabling unit **15820**) a plurality of control icons with different simulated three-dimensional characteristics; in accordance with a determination (e.g., with the determining unit **15822**) that the respective control icon is a first control icon with a first simulated three-dimensional characteristic, perform a first movement (e.g., with the moving unit **15814**) of the cursor in response to detecting the stationary press input; and in accordance with a determination (e.g., with the determining unit **15822**) that the respective control icon is a second control icon with a second simulated three-dimensional characteristic, different from the first simulated three-dimensional characteristic, perform a second movement (e.g., with the moving unit **15814**) of the cursor, different from the first movement of the cursor, in response to detecting the stationary press input.

In some embodiments, the amount of lateral movement of the cursor on the display unit **15802** is determined based on an amount of change in appearance of the respective control icon on the display unit **15802**.

In some embodiments, the amount of change in appearance of the respective control icon is determined based on the intensity of the contact on the touch-sensitive surface unit **15804**.

The operations in the information processing methods described above are, optionally, implemented by running one or more functional modules in information processing apparatus such as general purpose processors (e.g., as described above with respect to FIGS. **1**A and **3**) or application specific chips.

The operations described above with reference to FIGS. **9**A-**9**C are, optionally, implemented by components depicted in FIGS. **1**A-**1**B or FIG. **10**. For example, displaying operations **15702**-**15704**, detecting operation **15708**, changing operation **15712**, moving operation **15718**, reducing operation **15722**, and increasing operation **15728** are, optionally, implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface corresponds to a predefined event or sub-event, such as selection of an object on a user interface. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally utilizes or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

Adjusting Properties of a Virtual Brush

Many electronic devices include applications in which a user can draw drawings on a virtual canvas. In some situations, the user makes drawings by manipulating a user interface object that corresponds to a virtual drawing instrument (e.g., a virtual brush). The virtual drawing instrument includes one or more properties, associated with output generated from the virtual drawing instrument, that are adjustable. However, adjusting these properties frequently involves navigating through a set of menus or controls that can be confusing and time consuming (e.g., to adjust those output properties, the user has to, for example, go through an options menu or select buttons corresponding to the options in a toolbar). The embodiments described below provide a more convenient and intuitive interface by enabling the user to adjust an output property of the virtual drawing instrument with the same contact used for manipulating the user interface object that corresponds to the virtual drawing instrument. By changing the intensity of the contact, the user can adjust an output property (e.g., width, color, opacity,) of the virtual drawing instrument. Additionally, the user interface object optionally includes helpful indications of various output properties of the virtual drawing instrument, thereby providing the user with information that enables the user to use the virtual drawing instrument more quickly and efficiently.

FIGS. **11**A-**11**P illustrate exemplary user interfaces for adjusting properties of a virtual brush in accordance with some embodiments. The user interfaces in these figures are used to illustrate the processes described below, including the processes in FIGS. **12**A-**12**C. FIGS. **11**A-**11**P include intensity diagrams that show the current intensity of the contact on the touch-sensitive surface relative to a plurality of intensity thresholds including: a contact-detection intensity threshold (e.g., IT_0) a light press intensity threshold (e.g., "IT_L") that, optionally, corresponds to a minimum threshold for activating or enabling virtual brush input; and a deep press intensity threshold (e.g., "IT_D") that, optionally, corresponds to a threshold corresponding to a maximum virtual brush output width or thickness.

In some embodiments, the device is an electronic device with a separate display (e.g., display **450**) and a separate touch-sensitive surface (e.g., touch-sensitive surface **451**). In some embodiments, the device is portable multifunction device **100**, the display is touch-sensitive display system **112**, and the touch-sensitive surface includes tactile output generators **167** on the display (FIG. **1**A). For convenience of explanation, the embodiments described with reference to FIGS. **11**A-**11**P and FIGS. **12**A-**12**C will be discussed with reference to display **450** and a separate touch-sensitive surface **451**, however analogous operations are, optionally, performed on a device with a touch-sensitive display system **112** in response to detecting the contacts described in FIGS. **11**A-**11**P on the touch-sensitive display system **112** while displaying the user interfaces shown in FIGS. **11**A-**11**P on the touch-sensitive display system **112**; in such embodiments, the focus selector is, optionally: a respective contact, a representative point corresponding to a contact (e.g., a centroid of a respective contact or a point associated with a respective contact), or a centroid of two or more contacts detected on the touch-sensitive display system **112**, in place of cursor **16810**.

FIG. **11**A illustrates virtual canvas **16802** displayed on display **450**. Virtual canvas **16802** is associated with an application, such as a drawing application or a presentation application. A user will, in some circumstances, draw lines, curves, etc. on virtual canvas **16802** with a virtual brush associated with virtual canvas **16802**. The virtual brush is represented on display **450** by brush manipulation object **16804**. Output from the virtual brush (e.g., virtual brush strokes, such as a line, drawn on virtual canvas **16802**) is controlled in accordance with one or more output properties of the virtual brush and movement of brush manipulation object **16804** on display **450**. In some embodiments, the properties include one or more of width, thickness, color, opacity, and brush hardness (e.g., whether the virtual brush output more resembles strokes from an instrument with a softer tip, such as a physical paint brush, or from an instrument with a harder tip, such as a pen or marker).

A brush manipulation object includes one or more status indicators. For example, brush manipulation object **16804** includes output status indicator(s) **16806** and brush status boundary **16808**. Brush manipulation object **16804** include four output status indicators **16806**. The output status indicators **16806** move (e.g., converge) toward brush status boundary **16808** as an intensity of a contact controlling brush manipulation object **16804**, detected on touch-sensitive surface **451**, increases, and move away from brush status boundary **16808** as the intensity of the contact decreases. In some embodiments, brush status boundary **16808** is represented as a circle (e.g., as shown in FIGS. **11**A-**11**M).

A focus selector (e.g., cursor **16810**) is also displayed on display **450**. In some embodiments, cursor **16810** is a pointer.

FIG. **11**A illustrates contact **16812** being detected on touch-sensitive surface **451** (e.g., with an intensity slightly above IT_0) at location **16812**-*a* while cursor **16810** is located over brush manipulation object **16804**. Movement **16814** of contact **16812** from location **16812**-*a* (FIG. **11**A) to location **16812**-*b* (FIG. **11**B) is detected. In response to detection of the movement of contact **16812**, cursor **16810** is moved to location **16810**-*b* and brush manipulation object **16804** is moved to location **16804**-*b*, as shown in FIG. **11**B.

In FIGS. **11**A-**11**B, while cursor **16810** is located over brush manipulation object **16804**, the intensity of contact **16812** is increased (e.g., from an intensity slightly above IT_0 in FIG. **11**A to an intensity slightly below IT_L in FIG. **11**B). As the intensity of contact **16812** increases, output status indicators **16806** converge toward brush status boundary **16808**. The intensity of contact **16812** in FIG. **11**B does not increase above a minimum intensity threshold (e.g., IT_L in FIGS. **11A-11P**) for enabling output from brush manipulation object **16804**. In accordance with the increase in the intensity of contact **16812**, where the intensity does not increase above threshold IT_L, no virtual brush output is generated along the movement path of brush manipulation object **16804**. This no-output status is indicated by output status indicators **16806** converging toward but not reaching brush status boundary **16808**. However, the movement of the status indicators **16806** provides visual feedback to the user indicating progress of the user towards starting to draw with the virtual brush and indicating an additional amount of intensity that would cause the virtual brush to start drawing on the virtual canvas.

Thus, whether a virtual brush output is generated, as a brush manipulation object (e.g., brush manipulation object **16804**) moves across a virtual canvas, and the type of output that is generated, is based on the intensity of the contact controlling the brush manipulation object (e.g., contact **16812** or **16816**). As the intensity changes, the appearance of the brush manipulation object changes. In some embodiments, a status boundary (e.g., status boundary **16808**, corresponding to the minimum intensity threshold for enabling output, such as IT_L) indicates a point at which the contact has a sufficiently high intensity to activate generation of virtual brush output. In some embodiments, a change in the appearance of the brush manipulation object in accordance with the change in intensity includes one or more output status indicators (e.g., output status indicators **16806**) moving toward or away from a brush status boundary (e.g., brush status boundary **16808**).

FIG. **11C** illustrates brush manipulation object **16804** displayed at location **16804**-*c*. Cursor **16810** is displayed over brush manipulation object **16804**, at location **16810**-*c*. Contact **16816** is detected on touch-sensitive surface **451** at location **16816**-*a*. An increase in the intensity of contact **16816** from an intensity below IT_L (e.g., an intensity slightly above IT_0) to an intensity above threshold IT_L is detected. In response to the detection of the intensity increase, generation of virtual brush output from brush manipulation object **16804** is enabled, indicated by output status indicators **16806** converging to touch brush status boundary **16808** and output indicator **16818** being displayed in brush manipulation object **16804**. In some embodiments, output indicator **16818** gives a visual indication of, not only that generation of virtual brush output is enabled, but also a width or thickness (and optionally also color and/or opacity) of the output (e.g., virtual brush strokes) that is generated as brush manipulation object **16804** moves across virtual canvas **16802**. For example, output indicator **16818** has a width, color, and/or opacity that matches the corresponding output width, color, and/or opacity of the virtual brush. In some embodiments, output indicator **16818** is displayed in the center or centroid position of brush manipulation object **16804** and remains in the center/centroid position of brush manipulation object **16804** as brush manipulation object **16804** moves across virtual canvas **16802**.

FIGS. **11C-11D** illustrates contact **16816** moving **16820**, to location **16816**-*b* on touch-sensitive surface **451**, while the intensity of contact **16816** is above IT_L. In response to detection of the movement of contact **16816**, cursor **16810** moves to location **16810**-*d*, brush manipulation object **16804** moves to location **16804**-*d*, and stroke **16822** (e.g., a line) is generated on virtual canvas **16802** in accordance with the movement of brush manipulation object **16804** (e.g., along the path of output indicator **16818**), as shown in FIG. **11D**. Stroke **16822** has a width that is determined in accordance with the intensity of contact **16816**. For example, at an intensity of contact **16816** that is within a predefined range above threshold IT_L, stroke **16822** has an initial line width, and the size of output indicator **16818** corresponds to this initial line width. In some embodiments, the line width or thickness changes continuously in accordance with the change in the contact intensity (while the intensity remains above threshold IT_L). In some embodiments, the line width or thickness changes discretely in accordance with the change in the contact intensity. For example, an intensity within a first incremental range of intensities above threshold IT_L corresponds to a first line width, and an intensity within the next incremental range of intensities correspond to a second, different line width.

FIGS. **11E-11G** illustrate continued movement **16824** of contact **16816**, toward location **16816**-*d*. While contact **16816** moves **16824**-*a* from location **16816**-*b* in FIG. **11E** to location **16816**-*c* in FIG. **11F** and then moves **16824**-*b* to location **16816**-*d* in FIG. **11G**, the intensity of contact **16816**, already above threshold IT_L, is increased further. In response to detection of the movement **16824** of contact **16816** in FIGS. **11E-11G**, cursor **16810** moves to location **16810**-*e* in FIG. **11F** and location **16810**-*g* in FIG. **11G**, brush manipulation object **16804** moves to location **16804**-*e* in FIG. **11F** and location **16804**-*g* in FIG. **11G**, and stroke **16826** is generated on virtual canvas **16802** in accordance with the movement of brush manipulation object **16804**, as shown in FIGS. **11F-11G**. The width of stroke **16826** increases, and output indicator **16818** increases in size, in accordance with the increase in the intensity of contact **16816** as brush manipulation object **16804** moves.

Virtual brush output (e.g., stroke **16822** and/or **16826**) generated from brush manipulation object **16804** optionally has a maximum width or thickness, which corresponds to a predefined intensity threshold (e.g., IT_D). In some embodiments, the size of brush status boundary **16808** corresponds to the maximum width or thickness. For example, as the intensity of contact **16816** increases above IT_L, output indicator **16818** increases in size to reflect the increasing width/thickness, in accordance with the increase in the intensity. When the intensity is increased to IT_D, the size of output indicator **16818** is the size of brush status boundary **16808**. If the intensity of contact **16816** is increased above IT_D, the line width or thickness does not increase further, and the size of output indicator **16818** does not increase further.

In FIGS. **11C-11G**, increases in the intensity above IT_L the device changes the line width or thickness. In some embodiments, intensity increases above IT_L the device changes other properties of virtual brush output generated from the brush manipulation object, such as the color or opacity (e.g., instead of or in addition to the line width or thickness). For example, increasing the intensity makes the stroke less transparent. As another example, increasing the intensity changes the color of the stroke or, for a particular color of the stroke, the shade of the color (e.g., lighter or darker shade). In some embodiments, the output property that is controlled by the contact intensity is user-changeable (e.g., in an options menu).

In some embodiments, when a property of virtual brush output generated from a brush manipulation object (e.g., brush manipulation object **16804**) is changed in accordance with a change in the intensity of a contact controlling the brush manipulation object, the property change affects virtual brush output generated after the change in the property; already-generated virtual brush output is unaffected. For example, when a stroke is being drawn and the width is changed while the drawing is in progress, the width of the already-drawn portion of the stroke is unchanged and the portion of the stroke drawn after the width change has the new width. As another example, when the color is changed between strokes, the color of the stroke drawn prior to the color change is unaffected by the color change.

FIG. **11**H illustrates brush manipulation object **16804** displayed at location **16804**-*g*. Cursor **16810** is displayed over brush manipulation object **16804**, at location **16810**-*g*. Contact **16828** is detected on touch-sensitive surface **451** at location **16828**-*a*. Contact **16828** has an intensity that is above IT_L; virtual brush output is enabled and output indicator **16818** is displayed in brush manipulation object **16804**. A second contact, contact **16830**, is also detected on touch-sensitive surface **451**. Movement **16831** of contact **16828** around contact **16830**, is detected.

In response to detection of the movement of contact **16828**, contact **16828** moves **16831** to location **16828**-*b*, as shown in FIG. **11**I. In accordance with the movement **16831** of contact **16828**, brush manipulation object **16804** and cursor **16810** move to locations **16804**-*h* and **16810**-*h*, respectively, around location **16833**, which corresponds to contact **16830**. In FIGS. **11**H-**11**I, a constant distance between location **16833** and brush manipulation object **16804** is maintained by the device. In some embodiments, the constant distance is determined based on the initial distance between contact **16828** and contact **16830** (e.g., a linear multiple of the initial distance between contact **16828** and contact **16830**). Brush manipulation object **16804** draws stroke **16832** along its movement path (e.g., because the intensity of contact **16828** is above IT_L). Stroke **16832** has a width that is in accordance with the intensity of contact **16828**. Stroke **16832** has a path that follows the movement of contact **16828** around location **16833**. Thus, contact **16830** is analogous to the fixed or pivot point of a compass, and contact **16828** is analogous to the drawing point of the compass.

FIG. **11**J illustrates brush manipulation object **16804** displayed at location **16804**-*i*. Cursor **16810** is displayed over brush manipulation object **16804**, at location **16810**-*i*. Contact **16834** is detected on touch-sensitive surface **451** at location **16834**-*a*. Contact **16834** has an intensity that is above threshold IT_L; virtual brush output is enabled and output indicator **16818** is displayed in brush manipulation object **16804**. Movement of contact **16834** in direction **16836** is detected. In response to detection of the movement **16836** of contact **16834**, contact **16834** moves to location **16834**-*b*, as shown in FIG. **11**K. In accordance with the movement **16836** of contact **16834**, brush manipulation object **16804** and cursor **16810** move to locations **16804**-*j* and **16810**-*j*, respectively. Brush manipulation object **16804** draws stroke **16838** along its movement path. In FIG. **11**K, stroke **16838** has a width that is in accordance with the intensity of contact **16828**.

While at location **16834**-*b*, contact **16834** is rotated in direction **16840**, around an axis (not shown) perpendicular to display **450** (e.g., as shown in FIGS. **11**K-**11**L). In response to the rotation of contact **16834**, a virtual brush output property that is different than width or thickness is changed in accordance with the rotation of contact **16834**. In some embodiments, the property that is changed in accordance with the contact rotation is color, opacity, or brush hardness.

After the rotation of contact **16834**, contact **16834** moves **16842**, as shown in FIGS. **11**L-**11**M from location **16834**-*b* in FIG. **11**L to location **16834**-*c* in FIG. **11**M. In response to detection of the movement **16842** of contact **16834**, the device moves brush manipulation object **16804** and cursor **16810** from locations **16804**-*j* and **16810**-*j* in FIG. **11**L to locations **16804**-*k* and **16810**-*k* in FIG. **11**M, respectively. Brush manipulation object **16804** draws stroke **16844** along its movement path in FIGS. **11**L-**11**M. In FIG. **11**M, stroke **16844** has a width that is in accordance with the intensity of contact **16828**. In accordance with the rotation of contact **16834**, stroke **16844** has an opacity and/or color that is different from the opacity and/or color of stroke **16838**.

FIGS. **11**A-**11**N illustrate one example of a brush manipulation object, namely brush manipulation object **16804** that is circular and includes output status indicators **16806** and brush status boundary **16808**. FIGS. **11**N-**11**P illustrate another example of a brush manipulation object. FIG. **11**N illustrates brush manipulation object **16846** displayed on display **450**, in virtual canvas **16802**. Brush manipulation object **16846** is shaped like crosshairs and does not include output status indicators **16806** and brush status boundary **16808**.

FIG. **11**N also shows cursor **16810** displayed over brush manipulation object **16846** and contact **16848** detected on touch-sensitive surface **451** (e.g., with an intensity slightly above IT_0) while cursor **16810** is located over brush manipulation object **16846**. An increase in the intensity of contact **16848** is detected, as shown in FIGS. **11**N-**11**P (e.g., from an intensity below IT_L in FIG. **11**N to an intensity above IT_L in FIG. **11**O).

In response to detection of the increase in the intensity of contact **16848**, bar **16850** is displayed adjacent to brush manipulation object **16846**. In some embodiments, bar **16850** is displayed in response to detection of a change (increase or decrease) in the intensity of contact **16848**. In some embodiments, bar **16850** is also displayed adjacent to brush manipulation object **16804** in response to detection of a change (increase or decrease) in the intensity of the contact controlling brush manipulation object **5404**. Bar **16850** fills up as the intensity of a contact controlling brush manipulation object **16846** increases, and empties as the intensity decreases. In response to detection of an increase in the intensity of contact **16848** beyond a minimum threshold (e.g., IT_L), output indicator **16818** is displayed, as shown in FIGS. **11**O-**11**P. The size of output indicator **16818** increases as the intensity of contact **16848** increases, indicating an increase in the width or thickness of virtual brush output generated from brush manipulation object **16846** when brush manipulation object **16846** is moved. Output indicator **16818** increases to a maximum size that is indicative of a maximum output width or thickness, as shown in FIG. **11**P. The maximum size of output indicator **16818** corresponds to a predefined intensity threshold (e.g., IT_D) above which the width/thickness does not change any further in response to an increase in intensity of an associated contact. Brush manipulation object **16846** is configured to move across virtual canvas **16802** in accordance with movement of contact **16848** that is detected on touch-sensitive surface **451**. Thus, in some embodiments, virtual brush output is drawn on virtual canvas **16802** along a path of movement of brush manipulation object **16846** whenever the intensity of contact **16848** is above threshold IT_L during the movement of contact **16848**.

FIGS. **12**A-**12**C are flow diagrams illustrating a method **16900** of adjusting properties of a virtual brush in accordance with some embodiments. The method **16900** is performed at an electronic device (e.g., device **300**, FIG. **3**, or portable multifunction device **100**, FIG. **1**A) with a display and a touch-sensitive surface. In some embodiments, the display is a touch screen display and the touch-sensitive surface is on the display. In some embodiments, the display is separate from the touch-sensitive surface. Some operations in method **16900** are, optionally combined and/or the order of some operations is, optionally changed.

As described below, the method **16900** provides an intuitive way to adjust properties of a virtual brush. The method reduces the cognitive burden on a user when adjusting properties of a virtual brush, thereby creating a more efficient human-machine interface. For battery-operated electronic devices, enabling a user to adjust properties of a virtual brush faster and more efficiently conserves power and increases the time between battery charges.

The device displays (**16902**) a brush manipulation object on the display, where the output of a virtual brush on a virtual canvas is controlled in accordance with one or more output properties of the virtual brush and movement of the brush manipulation object on the display. For example, FIG. **11**A illustrates brush manipulation object **16804** displayed on display **450**, in virtual canvas **16802**. Virtual brush output generated from brush manipulation object **16804** is controlled in accordance with one or more properties of the virtual brush and movement of brush manipulation object **16804** on display **450**.

While a focus selector is over or adjacent to the brush manipulation object, the device detects (**16904**) an increase in intensity of a first contact on the touch-sensitive surface. FIGS. **11**A-**11**B and illustrate the increase in intensity of contact **16812** controlling brush manipulation object **16804** while cursor **16810** is located over brush manipulation object **16804**. FIGS. **11**C-**11**G and illustrate the increase in intensity of contact **16816** controlling brush manipulation object **16804** while cursor **16810** is located over brush manipulation object **16804**. FIGS. **11**N-**11**P and illustrate the increase in intensity of contact **16848** controlling brush manipulation object **16804** while cursor **16810** is located over brush manipulation object **16846**.

In response (**16906**) to detecting the increase in intensity of the first contact, the device adjusts (**16908**) a first output property of the virtual brush in accordance with the increase in intensity of the first contact. In FIGS. **11**C-**11**G, for example, virtual brush output and a width of the output is changed in accordance with the increase in the intensity of contact **16816**. In some embodiments, the first output property is (**16910**) a property selected from the set consisting of: line width, line color, and line opacity. In FIGS. **11**C-**11**G, for example, the output property that is changed in accordance with the increase in the intensity of contact **16816** is the line width of the output.

Also, in response (**16906**) to detecting the increase in intensity of the first contact, the device adjusts (**16916**) an appearance of the brush manipulation object in accordance with the change in the first output property of the virtual brush. In FIGS. **11**A-**11**G, for example, the appearance of brush manipulation object **16804** is changed in accordance with the increase in the intensity of contact **16812** (e.g., output status indicators **16806** have moved toward brush status boundary **16808**). In FIGS. **11**C-**11**G, for example, the appearance of brush manipulation object **16804** is changed in accordance with the increase in the intensity of contact **16816** (e.g., output indicator **16818** is displayed and increases in size as the intensity of contact **16816** increases). In some embodiments, the brush includes a single drawing point. In some embodiments, the virtual brush includes multiple drawing points. In some embodiments, adjusting the appearance of the brush manipulation object includes (**16918**) displaying a bar that fills up as the intensity of the first contact increases. FIGS. **11**N-**11**O, for example, illustrates bar **16850** displayed adjacent to brush manipulation object **16846** as the intensity of contact **16848** increases.

In some embodiments, adjusting the appearance of the brush manipulation object includes (**16920**) displaying a brush output status indicator that moves towards a brush status boundary in accordance with an intensity of the first contact, and adjusting the first output property of the virtual brush includes a binary change in the output of the virtual brush when the status indicator reaches the brush status boundary (e.g., start/stop drawing, change color). In FIGS. **11**A-**11**G, for example, in accordance with the intensity of a contact (e.g., contact **16812** or **16816**), output status indicators **16806** move toward brush status boundary **16808**. When the intensity does not increase above a respective intensity threshold (e.g., IT_L), as is the case of contact **16812** in FIG. **11**B, output status indicators **16806** move toward but do not reach brush status boundary **16808**, and virtual brush output is not enabled. When the intensity increases above the respective intensity threshold (e.g., IT_L), as is the case of contact **16816** in FIG. **11**C, output status indicators **16806** move toward and reach brush status boundary **16808**, and virtual brush output is enabled.

In some embodiments, adjusting the first output property of the virtual brush includes (**16921**) a continuous change in the output of the virtual brush that corresponds to an increase in intensity of the first contact after the status indicator reaches the brush status boundary. In contrast, as described above, in some embodiments, before the status indicator reaches the brush status boundary, there is no output of the virtual brush, when the status indicator reaches the brush status boundary, the virtual brush has an initial output corresponding to an initial line width, and when the intensity of the first contact continues to increase beyond the intensity at which the status indicator reaches the brush status boundary, the line width of the virtual brush increases gradually to a maximum line width in accordance with the increase in intensity of the contact. For example, in FIGS. **11**E-**11**G, the width of stroke **16826** increases continuously in accordance with the increase in the intensity of contact **16816** above threshold IT_L (e.g., output status indicators **16806** has reached brush status boundary **16808**). In some embodiments, the brush status boundary corresponds (**16922**) to a maximum size of the virtual brush (e.g., the brush status boundary is a circle and a marker moves toward the brush status boundary from the outside of the circle and the circle delineates a maximum brush width of the brush). For example, in FIG. **11**G, output indicator **16818** increases up to the size of brush status boundary **16808** in accordance with the increase in the intensity of contact **16816**. The maximum size of output indicator **16818** corresponds to the maximum width of stroke **16826**.

In some embodiments, the device detects (**16924**) movement of the first contact on the touch-sensitive surface (e.g., prior to, during or after detecting the increase in intensity of the first contact on the touch-sensitive surface), and moves (**16926**) the brush manipulation object on the display in accordance with the movement of the first contact on the touch-sensitive surface. For example, brush manipulation object **16804** moves in accordance with the movement **16814** of contact **16812**, as shown in FIGS. **11**A-**11**B or in accordance with the movement **16820** and **16824** of contact **16816**, as shown in FIGS. **11**C-**11**G.

In some embodiments, while detecting the first contact, the device detects (**16928**) a second contact on the touch-sensitive surface and detects movement (**16930**) of the first contact on the touch-sensitive surface. In response to detecting the movement of the first contact on the touch-sensitive surface, the device moves (**16932**) the brush manipulation object around a location on the display corresponding to the second contact in accordance with a predefined constraint (e.g., the brush acts as a virtual compass with a second contact acting as a fixed point of the compass). As FIGS. **11**H-**11**I show, for example, contact **16828** moves around concurrently detected contact **16830**. In response to detection of the movement of contact **16828** around contact **16830**, brush manipulation object **16804** moves around location **16833**, which corresponds to contact **16830**, with a constant distance maintained between brush manipulation object **16804** and location **16833**.

In some embodiments, the device moves (**16934**) the brush manipulation object while the one or more output properties of the virtual brush meet predefined output generation criteria, and while moving the brush manipulation object, (e.g., in response to movement of the first contact on the touch-sensitive surface that corresponds to movement of the brush manipulation object), the device generates (**16936**) an output of the virtual brush on the virtual canvas in accordance with movement of the brush manipulation object. For example, in FIGS. **11**C-**11**E, brush manipulation object **16804** is moved while virtual brush output is enabled with a non-zero width. In response to the movement of brush manipulation object **16804**, stroke **16822** is generated while brush manipulation object **16804** is moving, along the path of movement of brush manipulation object **16804**.

In some embodiments, while a focus selector is over the brush manipulation object, the device detects (**16938**) a change in rotation of the first contact on the touch-sensitive surface. In response to detecting the change in rotation of the first contact, the device adjusts (**16940**) a second output property of the virtual brush in accordance with the change in rotation of the first contact, where the second output property is different from the first output property. For example, FIGS. **11**J-**11**M show the width of virtual brush output being determined based on the intensity of contact **16834** and the opacity and/or color of virtual brush output being determined based on the rotation of contact **16834**. In some embodiments, the first output property includes (**16942**) a thickness of a line corresponding to the virtual brush, and the second output property is an output property selected from the set consisting of: a color of the line, an opacity of the line, and a hardness of the virtual brush. For example, FIGS. **11**J-**11**M show the width of virtual brush output being determined based on the intensity of contact **16834** and the opacity and/or color of virtual brush output being determined based on the rotation of contact **16834**.

It should be understood that the particular order in which the operations in FIGS. **12**A-**12**C have been described is merely exemplary and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that details of other processes described herein with respect to other methods described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments) are also applicable in an analogous manner to method **16900** described above with respect to FIGS. **12**A-**12**C. For example, the contacts, intensity thresholds, and focus selectors described above with reference to method **16900** optionally have one or more of the characteristics of the contacts, intensity thresholds, and focus selectors described herein with reference to other methods described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments). For brevity, these details are not repeated here.

In accordance with some embodiments, FIG. **13** shows a functional block diagram of an electronic device **17000** configured in accordance with the principles of the various described embodiments. The functional blocks of the device are, optionally, implemented by hardware, software, or a combination of hardware and software to carry out the principles of the various described embodiments. It is understood by persons of skill in the art that the functional blocks described in FIG. **13** are, optionally, combined or separated into sub-blocks to implement the principles of the various described embodiments. Therefore, the description herein optionally supports any possible combination or separation or further definition of the functional blocks described herein.

As shown in FIG. **13**, an electronic device **17000** includes a display unit **17002** configured to display a brush manipulation object on the display unit **17002**, wherein the output of a virtual brush on a virtual canvas is controlled in accordance with one or more output properties of the virtual brush and movement of the brush manipulation object on the display unit **17002**; a touch-sensitive surface unit **17004** configured to receive contacts; one or more sensors **17006** configured to detect intensity of contacts with the touch-sensitive surface unit **17004**; and a processing unit **17008** coupled to the display unit **17002**, the touch-sensitive surface unit **17004** and the one or more sensors **17006**. In some embodiments, the processing unit **17008** includes a detecting unit **17010**, an adjusting unit **17012**, a moving unit **17014**, a generating unit **17016**, and a display enabling unit **17018**.

The processing unit **17008** is configured to: while a focus selector is over or adjacent to the brush manipulation object, detect an increase in intensity of a first contact on the touch-sensitive surface unit **17004** (e.g., with the detecting unit **17010**); and in response to detecting the increase in intensity of the first contact: adjust a first output property of the virtual brush in accordance with the increase in intensity of the first contact (e.g., with the adjusting unit **17012**), and adjust an appearance of the brush manipulation object in accordance with the change in the first output property of the virtual brush (e.g., with the adjusting unit **17012**).

In some embodiments, the processing unit **17008** is configured to: detect movement of the first contact on the touch-sensitive surface unit **17004** (e.g., with the detecting unit **17010**), and move the brush manipulation object on the display unit **17002** in accordance with the movement of the first contact on the touch-sensitive surface unit **17004** (e.g., with the moving unit **17014**).

In some embodiments, the processing unit **17008** is configured to: while detecting the first contact, detect a second contact on the touch-sensitive surface unit **17004** (e.g., with the detecting unit **17010**), detect movement of the first contact on the touch-sensitive surface unit **17004** (e.g., with the detecting unit **17010**), and in response to detecting the movement of the first contact on the touch-sensitive surface unit **17004**, move the brush manipulation object around a location on the display unit **17002** corresponding to the second contact in accordance with a predefined constraint (e.g., with the moving unit **17014**).

In some embodiments, the processing unit **17008** is configured to: move the brush manipulation object while the one or more output properties of the virtual brush meet predefined output generation criteria (e.g., with the moving unit **17014**), and while moving the brush manipulation object, generate an output of the virtual brush on the virtual canvas in accordance with movement of the brush manipulation object (e.g., with the generating unit **17016**).

In some embodiments, the first output property is a property selected from the set consisting of: line width, line color, and line opacity.

In some embodiments, adjusting the appearance of the brush manipulation object includes enabling display of a bar that fills up as the intensity of the first contact increases.

In some embodiments, adjusting the appearance of the brush manipulation object includes enabling display of a brush output status indicator that moves towards a brush status boundary in accordance with an intensity of the first contact (e.g., with the display enabling unit **17018**), and adjusting the first output property of the virtual brush includes a binary change in the output of the virtual brush when the status indicator reaches the brush status boundary (e.g., with the adjusting unit **17012**).

In some embodiments, adjusting the first output property of the virtual brush includes a continuous change in the output of the virtual brush that corresponds to an increase in intensity of the first contact after the status indicator reaches the brush status boundary.

In some embodiments, the brush status boundary corresponds to a maximum size of the virtual brush.

In some embodiments, the processing unit **17008** is configured to: while a focus selector is over the brush manipulation object, detect a change in rotation of the first contact on the touch-sensitive surface unit **17004** (e.g., with the detecting unit **17010**), and in response to detecting the change in rotation of the first contact, adjust a second output property of the virtual brush in accordance with the change in rotation of the first contact, wherein the second output property is different from the first output property (e.g., with the adjusting unit **17012**).

In some embodiments, the first output property includes a thickness of a line corresponding to the virtual brush, and the second output property is an output property selected from the set consisting of: a color of the line, an opacity of the line, and a hardness of the virtual brush.

The operations in the information processing methods described above are, optionally implemented by running one or more functional modules in information processing apparatus such as general purpose processors (e.g., as described above with respect to FIGS. **1**A and **3**) or application specific chips.

The operations described above with reference to FIGS. **12**A-**12**C are, optionally implemented by components depicted in FIGS. **1**A-**1**B or FIG. **13**. For example, detection operation **16904** and adjusting operations **16908** and **16916** are, optionally implemented by event sorter **170**, event recognizer **180**, and event handler **190**. Event monitor **171** in event sorter **170** detects a contact on touch-sensitive display **112**, and event dispatcher module **174** delivers the event information to application **136-1**. A respective event recognizer **180** of application **136-1** compares the event information to respective event definitions **186**, and determines whether a first contact at a first location on the touch-sensitive surface corresponds to a predefined event or sub-event, such as selection of an object on a user interface. When a respective predefined event or sub-event is detected, event recognizer **180** activates an event handler **190** associated with the detection of the event or sub-event. Event handler **190** optionally utilizes or calls data updater **176** or object updater **177** to update the application internal state **192**. In some embodiments, event handler **190** accesses a respective GUI updater **178** to update what is displayed by the application. Similarly, it would be clear to a person having ordinary skill in the art how other processes can be implemented based on the components depicted in FIGS. **1**A-**1**B.

It should be understood that the particular order in which the operations have been described above is merely exemplary and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein. Additionally, it should be noted that the various processes separately described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments) can be combined with each other in different arrangements. For example, the contacts, user interface objects, tactile sensations, intensity thresholds, and/or focus selectors described above with reference to any one of the various processes separately described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments) optionally have one or more of the characteristics of the contacts, gestures, user interface objects, tactile sensations, intensity thresholds, and focus selectors described herein with reference to one or more of the other methods described herein (e.g., those listed in the fifth paragraph of the Description of Embodiments). For brevity, all of the various possible combinations are not specifically enumerated here, but it should be understood that the claims described above may be combined in any way that is not precluded by mutually exclusive claim features.

The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the various described embodiments to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the various described embodiments and their practical applications, to thereby enable others skilled in the art to best utilize the various described embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A non-transitory computer readable storage medium storing one or more programs, the one or more programs comprising instructions, which, when executed by an electronic device with a display, a touch-sensitive surface and one or more sensors to detect intensities of contacts with the touch-sensitive surface, cause the electronic device to:
- display a respective control icon with simulated three-dimensional characteristics;
- display a cursor over the respective control icon;
- detect, on the touch-sensitive surface, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor; and
- in response to detecting the stationary press input:
  - change an appearance of the simulated three-dimensional characteristics of the respective control icon; and
  - move the cursor laterally on the display in accordance with the change in appearance of the simulated three-dimensional characteristics of the respective control icon wherein the amount of lateral movement of the cursor on the display is determined based on an amount of change in appearance of the simulated three-dimensional characteristics of the respective control icon on the display.

2. The non-transitory computer readable storage medium of claim **1**, wherein the respective control icon moves laterally on the display to simulate downward motion of a button when viewed at an angle.

3. The non-transitory computer readable storage medium of claim **1**, wherein:

the cursor is stationary relative to the respective control icon; and

the cursor moves laterally relative to a background.

4. The non-transitory computer readable storage medium of claim **1**, including instructions which cause the electronic device to, in response to detecting the stationary press input, reduce a size of the cursor in accordance with the increase in intensity of the contact.

5. The non-transitory computer readable storage medium of claim **1**, including instructions which cause the electronic device to, after detecting the increase in intensity of the contact that corresponds to the cursor:

detect, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor; and

in response to detecting the decrease in intensity of the contact, increase a size of the cursor in accordance with the decrease in intensity of the contact.

6. The non-transitory computer readable storage medium of claim **1**, including instructions which cause the electronic device to, after detecting the increase in intensity of the contact that corresponds to the cursor:

detect, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor;

in response to detecting the decrease in intensity of the contact:

change the appearance of the simulated three-dimensional characteristics of the respective control icon; and

move the cursor laterally on the display in accordance with the change in appearance of the simulated three-dimensional characteristics of the respective control icon in a direction that is substantially opposite to a direction in which the cursor was moved in response to detecting the increase in intensity of the contact that corresponds to the cursor.

7. The non-transitory computer readable storage medium of claim **1**, including instructions which cause the electronic device to, prior to detecting the stationary press input:

detect movement of the contact on the touch-sensitive surface; and

in response to detecting movement of the contact on the touch-sensitive surface, move the cursor in accordance with the movement of the contact.

8. The non-transitory computer readable storage medium of claim **1**, including instructions which cause the electronic device to:

display a plurality of control icons with different simulated three-dimensional characteristics;

in accordance with a determination that the respective control icon is a first control icon with a first simulated three-dimensional characteristic, perform a first movement of the cursor in response to detecting the stationary press input; and

in accordance with a determination that the respective control icon is a second control icon with a second simulated three-dimensional characteristic, different from the first simulated three-dimensional characteristic, perform a second movement of the cursor, different from the first movement of the cursor, in response to detecting the stationary press input.

9. The non-transitory computer readable storage medium of claim **1**, wherein the amount of change in appearance of the simulated three-dimensional characteristics of the respective control icon is determined based on the intensity of the contact on the touch-sensitive surface.

10. An electronic device, comprising:

a display;

a touch-sensitive surface;

one or more sensors to detect intensities of contacts with the touch-sensitive surface;

one or more processors;

memory; and

one or more programs, wherein the one or more programs are stored in the memory and configured to be executed by the one or more processors, the one or more programs including instructions for:

displaying a respective control icon with simulated three-dimensional characteristics;

displaying a cursor over the respective control icon;

detecting, on the touch-sensitive surface, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor; and

in response to detecting the stationary press input:

changing an appearance of the simulated three-dimensional characteristics of the respective control icon; and

moving the cursor laterally on the display in accordance with the change in appearance of the simulated three-dimensional characteristics of the respective control icon wherein the amount of lateral movement of the cursor on the display is determined based on an amount of change in appearance of the simulated three-dimensional characteristics of the respective control icon on the display.

11. The electronic device of claim **10**, wherein the respective control icon moves laterally on the display to simulate downward motion of a button when viewed at an angle.

12. The electronic device of claim **10**, wherein:

the cursor is stationary relative to the respective control icon; and

the cursor moves laterally relative to a background.

13. The electronic device of claim **10**, including instructions for, in response to detecting the stationary press input, reduce a size of the cursor in accordance with the increase in intensity of the contact.

14. The electronic device of claim **10**, including instructions for, after detecting the increase in intensity of the contact that corresponds to the cursor:

detecting, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor; and

in response to detecting the decrease in intensity of the contact, increasing a size of the cursor in accordance with the decrease in intensity of the contact.

15. The electronic device of claim **10**, including instructions for, after detecting the increase in intensity of the contact that corresponds to the cursor:

detecting, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor;

in response to detecting the decrease in intensity of the contact:

changing the appearance of the simulated three-dimensional characteristics of the respective control icon; and

moving the cursor laterally on the display in accordance with the change in appearance of the simulated three-dimensional characteristics of the respective control icon in a direction that is substantially opposite to a direction in which the cursor was moved in response to detecting the increase in intensity of the contact that corresponds to the cursor.

16. The electronic device of claim **10**, including instructions for, prior to detecting the stationary press input:

detecting movement of the contact on the touch-sensitive surface; and

in response to detecting movement of the contact on the touch-sensitive surface, moving the cursor in accordance with the movement of the contact.

17. The electronic device of claim **10**, including instructions for:

displaying a plurality of control icons with different simulated three-dimensional characteristics;

in accordance with a determination that the respective control icon is a first control icon with a first simulated three-dimensional characteristic, performing a first movement of the cursor in response to detecting the stationary press input; and

in accordance with a determination that the respective control icon is a second control icon with a second simulated three-dimensional characteristic, different from the first simulated three-dimensional characteristic, performing a second movement of the cursor, different from the first movement of the cursor, in response to detecting the stationary press input.

18. The electronic device of claim **10**, wherein the amount of change in appearance of the simulated three-dimensional characteristics of the respective control icon is determined based on the intensity of the contact on the touch-sensitive surface.

19. A method, comprising:

at an electronic device with a display and a touch-sensitive surface, wherein the electronic device includes one or more sensors to detect intensities of contacts with the touch-sensitive surface:

displaying a respective control icon with simulated three-dimensional characteristics;

displaying a cursor over the respective control icon;

detecting, on the touch-sensitive surface, a stationary press input that includes an increase in intensity of a contact that corresponds to the cursor; and

in response to detecting the stationary press input:

changing an appearance of the simulated three-dimensional characteristics of the respective control icon; and

moving the cursor laterally on the display in accordance with the change in appearance of the simulated three-dimensional characteristics of the respective control icon wherein the amount of lateral movement of the cursor on the display is determined based on an amount of change in appearance of the simulated three-dimensional characteristics of the respective control icon on the display.

20. The method of claim **19**, wherein the respective control icon moves laterally on the display to simulate downward motion of a button when viewed at an angle.

21. The method of claim **19**, wherein:

the cursor is stationary relative to the respective control icon; and

the cursor moves laterally relative to a background.

22. The method of claim **19**, including, in response to detecting the stationary press input, reduce a size of the cursor in accordance with the increase in intensity of the contact.

23. The method of claim **19**, including, after detecting the increase in intensity of the contact that corresponds to the cursor:

detecting, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor; and

in response to detecting the decrease in intensity of the contact, increasing a size of the cursor in accordance with the decrease in intensity of the contact.

24. The method of claim **19**, including, after detecting the increase in intensity of the contact that corresponds to the cursor:

detecting, on the touch-sensitive surface, a decrease in intensity of the contact that corresponds to the cursor;

in response to detecting the decrease in intensity of the contact:

changing the appearance of the simulated three-dimensional characteristics of the respective control icon; and

moving the cursor laterally on the display in accordance with the change in appearance of the simulated three-dimensional characteristics of the respective control icon in a direction that is substantially opposite to a direction in which the cursor was moved in response to detecting the increase in intensity of the contact that corresponds to the cursor.

25. The method of claim **19**, including, prior to detecting the stationary press input:

detecting movement of the contact on the touch-sensitive surface; and

in response to detecting movement of the contact on the touch-sensitive surface, moving the cursor in accordance with the movement of the contact.

26. The method of claim **19**, including:

displaying a plurality of control icons with different simulated three-dimensional characteristics;

in accordance with a determination that the respective control icon is a first control icon with a first simulated three-dimensional characteristic, performing a first movement of the cursor in response to detecting the stationary press input; and

in accordance with a determination that the respective control icon is a second control icon with a second simulated three-dimensional characteristic, different from the first simulated three-dimensional characteristic, performing a second movement of the cursor, different from the first movement of the cursor, in response to detecting the stationary press input.

27. The method of claim **19**, wherein the amount of change in appearance of the simulated three-dimensional characteristics of the respective control icon is determined based on the intensity of the contact on the touch-sensitive surface.

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